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EDUCATION AND INDUSTRY TO EXTRACT

EDUCATION AND INDUSTRY. The problem of the relations of the school to industry and commerce is only part of the wider question of vocational training (*q.v.*), namely that of co-ordinating the preparation for livelihood (specialized training) with the existing preparation for life (general education), and deciding how much or how little of the former should given in the schools. The wide-spread neglect of the problem recent times seems all the more surprising, considering the ctical bent that has always distinguished the English genius. neglect is mainly due to two reasons, both historical.

he first is the comparative eclipse of the idea of vocational ning in the university sphere, an eclipse which lasted from Renaissance till the closing years of the 19th century. In middle ages the university was predominantly professional, vocational, its principal object being to turn out doctors in ology, law or medicine; the Latin and later the Greek authors lied were mainly regarded as providing the raw material for technical equipment of the future graduate whatever his fac- . The Renaissance gave a great impetus to the gospel of the ie of learning for its own sake, while in this country the in- ising resort of the aristocracy to the university that dates from same period tended to overshadow and obscure the more tly professional character of its work by the new ideal of its ig the finishing school of the scholar and the gentleman. Yet in case of the latter this seemingly general education was in a y real sense vocational, since the culture of the day and the er to handle his fellows (*mancraft*) acquired at the university e the indispensable stock in trade of a member of the ruling ses. On the other hand the ordinary mediaeval school, apart n certain monastic and a few other schools, was either pre- atory to the university or gave a general education, all technical ning in the then existing arts and crafts being provided outside school by a very complete system of apprenticeship (*q.v.*).

t was just this very system of apprenticeship which explains ts turn the absence until recently of the vocational idea from purview of education below the university. In fact it was only the gradual decay of apprenticeship since the beginning of the n century, and the increased demand for more scientific train- for the higher walks of industry towards the close of the same tury that the question came to the fore and efforts were made by the technical Education Acts of 1889 and 1891 and still more by the Education Act of 1902 to deal with the problem on a national scale (*see* TECHNICAL EDUCATION). Today it is realized that it is no longer a problem of technical education pure and simple, to be dealt with as a separate department, but a much wider one of bringing national education in all its stages, primary, secondary and university, into closer touch with commerce and industry without injuring the general education they provide.

GREAT BRITAIN

The main headings under which the relations between the school and industry may be considered both as regards the present conditions and future developments are as follows.—(1) The contact between the two as at present furnished by official or other machinery for placing out the products of the school in industry and commerce. (2) The contact already set up by means of trade and technical schools and colleges. (3) The contact at present existing in establishments of general education.

On many of these points the report of the committee on education and industry (first part 1927, second part 1928) throws valuable light. For certain reasons however, the committee ruled out of consideration what may be called the counting house side of commerce as well as the university's share in the problem.

Official Machinery.—The first attempts to create official machinery for the placing out of pupils dates from the establishment in 1909 of labour exchanges, subsequently known as employment exchanges, some of which contained not only juvenile departments but also juvenile advisory committees. Various legislative modifications have since taken place, including the introduction of the Board of Education, and today the work is either carried on by the Ministry of Labour through its local offices, normally assisted by a juvenile advisory committee, or else by local education authorities, where they have decided to undertake it through juvenile employment committees. These local authorities comprised in 1926 11 county councils, 56 county boroughs, 26 boroughs and 21 urban councils, the number of areas for which they were responsible being 166, while the Ministry of Labour looked after 191; in one or two cases the areas are divided between them. The work of the two types of committee are largely alike. Advice and information is furnished to boys and girls while still at school, through school conferences or individual interviews. In both cases particulars are collected from head-teachers on the character, ability and physical capacity of

[illegible] Other features of the work include the [illegible] of applicants, the keeping in touch with employers [illegible] to vacancies, etc., the putting forward of juveniles for [illegible] the keeping in touch with those who have got jobs, gen[illegible] own as "after care."

Juvenile employment committee contains a member of [illegible] education committee and normally representative em[illegible] orkers, voluntary social workers and teachers and those [illegible] nistry of Labour when they exist are organized on similar [illegible] amount of after care work by the committees is of con[illegible] value and volume. The number of situations found in [illegible] he Ministry of Labour and the local authorities com[illegible] mounted to the impressive number of 224,645, yet these [illegible] ly represent about 20% of the pupils leaving school [illegible] year. In addition a large number of posts are found by [illegible] elementary headmasters and headmistresses, specially [illegible] f central schools, and the headmasters and headmistresses [illegible] ary schools generally make a point of keeping in touch [illegible] oyers. Those in or around London have also joint agen[illegible] acing out boys and girls. Broadly speaking, a pupil com[illegible] e course in a secondary school has little difficulty in [illegible] a job. In trade schools and technical institutes the [illegible] roducts are readily absorbed by the business world. In [illegible] sities again appointment boards have been established. [illegible] mong certain big trading companies a growing demand [illegible] of a university type, especially for posts abroad, where [illegible] of character and grit are often a paramount consider[illegible] creasing numbers of scientific and technically trained [illegible] such as chemists, engineers, biologists, statisticians and [illegible] re being taken on by the bigger firms in this country, [illegible] e intake is still far below that of Germany. This ten[illegible] ikely to be further fostered by the growing amalgama[illegible] federations in industry, while still more recently the [illegible] he university student (man or woman) has been appre[illegible] the larger stores where manners and ability to manage [illegible] ses of employees are recognized as a business asset. [illegible] may also be made of the experiments conducted by the [illegible] of Industrial Psychology whose tests promise to be of [illegible] stance in the sorting out of pupils and the prevention [illegible] ial misfits.

[illegible] ration of Education and Commerce.—For the direct [illegible] ready established with trade and commerce through trade [illegible] ncluding those run by certain big firms, day and evening [illegible] ion schools, technical institutions and schools of art [illegible] cultural institutes, *see* the appropriate articles on [illegible] ect. Reference should also be made to the juvenile [illegible] ment-centres which are run as a sort of "ambulance" [illegible] or juveniles temporarily out of work. There is [illegible] fever of these being made permanent and some kind [illegible] ision appears to be necessary. One is the suggestion of [illegible] lishment of working certificates (in use in the United [illegible] which however is fraught with certain difficulties. The [illegible] estion is bound up however with the gap which at present [illegible] public supervision owing to pupils leaving the elementary [illegible] 14 and the scheme of national insurance only starting [illegible] e of 16. The remedy probably lies in some form of pro[illegible] of the existing school-age, though, unless extended [illegible] 6, this would still fail to affect the older juveniles. Most [illegible] es on education would prefer to raise the compulsory age [illegible] attendance to 15, following the lines of the Hadow [illegible] others pin their faith to day continuation schools from [illegible] with a possible extension to 18. With the growing im[illegible] onditions in workshops, the institution of trade boards, [illegible] introduction of welfare workers, the latter policy may [illegible] [illegible] for the work and fit the more [illegible] of [illegible] the [illegible] good [illegible] the [illegible] the [illegible] COMMERCIAL [illegible] there

more evening work, ranging as it does from simpler courses in the movements of commerce and technology to preparation for the higher walk of commerce and industry and including university work and even postgraduate research. But the whole is run on a voluntary basis and the leakage especially in the lower grades is, owing to various causes, considerable. It also leads to a good deal of overpressure owing to the long hours of business of many of the students, while in rural districts the problem is further complicated by the difficulties of travelling.

As regards contact with the elementary school, criticism from the business world of the latter has certainly decreased. Taking the elementary school as it is, the only improvements that appear feasible appear to lie in the provision of more handicraft and domestic work and in some cases a closer relation of the school instruction to the pupils' environment in industrial or rural districts (*see* RURAL EDUCATION), with visits to factories and places of business by the children still at school, if not by the formation of school-leaving classes, which seem to present a great many difficulties. But with the elementary school as at present constituted it is hard to see how the contact can be made closer. The central school with its technical and commercial bias seems to have established a very substantial contact with the business world. The secondary school, as pointed out elsewhere, incidentally gives in the English, Arithmetic, Geography and other subjects that it teaches a good deal of the technical equipment the pupil will require in commerce and to some extent in industry. Only 28·5 of its boys and only 7·1 of its girls enter industrial occupations, of whom only a fraction take up rural occupation as against 65·8 of the boys and 63·9 of the girls who select professional, commercial or clerical callings. From the point of view of industry it is clear that a widening of the present form of the school certificate would be desirable in the way of allowing the practical subjects, handicraft, art, domestic science, etc., more weight by permitting two of these instead of one to count towards the five necessary for a pass (*see* also EXAMINATIONS). There must be among the 34–40% who fail in the examination, not counting the 50% who do not take it all, many who would thus be able to qualify. Among the pupils over 16 it is interesting to note that there is a growing tendency to enter trade and technical schools and this should increase in the future. Again, as indicated above, the universities are sending an ever larger number into commerce and industry.

Conclusion.—(a) On the industrial side: in spite of much progress in the past, a vast amount still remains to be done. While the value of the school has steadily risen in the opinion of the more enlightened members of the business world, an enormous number of industrialists and traders are still largely uninformed of the work of the school. To organize them with a view to making them better acquainted with its work is an immense task. The departmental committee points out one serious difficulty—industry is mainly organized nationally, trade and commerce mainly locally and education locally. A step forward has however been taken. Their suggestion that a national advisory council for juvenile employment to consider the questions arising out of the first part of the report was adopted by the Ministry of Labour in Feb. 1928. The committee also formulated other suggestions for promoting closer co-operation between the two parties and inaugurating local enquiries, with a view ultimately to national action, and in this connection they recommended the Board of Education should establish a small special body representative of the view of employers, workers, local education authorities and teachers to undertake national negotiations the object of which should be to inform trade and industry of the educational system; to assist trade and industry in the formulation of their views, and to consider with educational authorities how far these views can be met. This committee was later appointed by the Board.

There is however one point with which the committees, intentionally or not, did not deal and that is the colossal cost of providing adequate technical training for all the various groups of industry and commerce throughout the country,—great as has been the advance of technical education in the past, there are obviously a large majority of business callings which are only

imperfectly if at all catered for under the existing provision of technical education. Possibly the cost can only be satisfactorily met if all the main trades and industries of the country organize themselves both on the side of employers and of trade unions to make some definite financial contribution to the national exchequer in return for the benefits received by their own particular industry.

(b) On the school side: among the schools themselves much may be expected as the Hadow scheme is gradually put in operation. An extra year added to school life would allow some sort of commercial or technical bias being given in the last year or two of the course, similar to that so successfully introduced in both central schools when first founded. An extension of the day continuation schools on vocational lines would also be helpful. The problem is a vast one yet in spite of its vastness nothing seems more certain than that the school and the industrial world are closer together than they have ever been before and that the existing gaps are likely to diminish with even greater rapidity in the near future. (C. Br.)

THE UNITED STATES

A study of the educational literature of the last half century reveals that the evolution of American education is rapidly tending toward a proper balance of the cultural and vocational objectives over which there has been so much strife in past decades between the proponents of general and practical education. Progressive leaders in the general education field now insist upon adequate provision for the practical education of all persons seeking occupational preparation, and the ablest vocational educators with equal emphasis insist that all persons seeking vocational preparation should first secure the most thorough fundamental general training which the capacities and resources of the trainees will permit. This balance is being accepted with a full recognition of the principle that educational adjustments must be made to fit individual needs to the extent that these do not conflict with society's interest in that general education which is essential for the common good of all citizens.

Occupational statistics for the United States indicate clearly that population is shifting from rural to urban centres and that the number of workers in industrial occupations is greatly increasing. This new economic development has brought with it a vigorous demand for industrial education. This demand is being met by both public and private agencies and is resulting in the industrial enlightenment of the general population along two lines, (1) consumption and (2) production.

Education for consumption is largely supported financially through the advertising campaigns of manufacturers who make products of commercial value which satisfy popular wants. In the best elementary and some secondary schools, however, school children are now being taught in carefully prepared lessons the true value of products offered the public to satisfy the desire for food, clothing, shelter, recreation, transportation and other necessaries. This early education in the grades also serves to introduce children to certain general aspects of industrial life and is further strengthened in later grades by handwork courses which develop muscular skill. Interest is also stimulated in the study of occupations through formal courses in the junior high school years and in the practical work of try-out laboratory courses which provide experiences typical and representative of community occupations to adolescents who, in many cases, are seeking early induction into industrial occupations. The steady discharge of juveniles 14 years of age and older from the schools into industry, whether caused by necessity or lack of interest in school work, has led to the further provision for a public guidance and placement service in many American cities, in order that working children may make better occupational adjustments than would be possible for them were they to seek work unassisted. In such communities continuation schools (*q.v.*) usually exist to give young workers 14 to 16, 17 or 18 years of age (as the State laws may require) further vocational and civic training on a part-time "learning while earning" programme, which calls for four to eight hours attendance weekly at these schools. This schooling aims to make economic and civic adjustment more satisfactory and certain than is possible when such children drift about in juvenile jobs without any educational guidance whatever.

Great variety characterizes training for productive efficiency Public senior, technical and co-operative high as well as continuation schools give both trade preparatory and trade extension courses in their day and evening classes for the more well defined trades of industry. While public secondary schools for both part and full time pupils have shops in which to give practical training in the more common occupations, it is, nevertheless, an accepted principle of vocational education, that the most effective practical instruction is given on the job in industry. Such practical training may embrace any practical instruction, requiring in some instances only a few days or even hours to master, as in highly and narrowly specialized operations, or as much as five years in some of the very complex all-round trades. Industry provides the short-time training in vestibule schools and the all-round trade training through apprenticeship under indenture agreements with the trainee. The public day and evening vocational schools give such trainees the necessary related theoretical training.

Private industrial initiative, however, since 1916, has greatly extended educational opportunity in industry. In the larger industrial corporations of international reputation extensive industrial training of workers and executives (*see* also Employers, Training of) has been undertaken in the form of foreman training classes and corporate trade and engineering schools. One of these, the General Motors Corporation, has established the Institute of Technology at Flint, Mich., to which co-operative engineering students from the many units of the corporation are sent in alternate months for engineering training to supplement the practical instruction received by them in the shops of the units sending them. So great is the need for industrial education on all levels of maturity that even the units of this corporation make use of available training agencies other than their own. Thus, the Frigidaire Corporation, a General Motors unit at Dayton, O., for example, sends co-operative students not only to the institute at Flint, but also to the University of Cincinnati and Antioch college in Ohio and augments this effort further by co-operative relations with the technical high school of the city of Dayton. The Ford Motor Company and the Westinghouse Electric Manufacturing Company are other notable examples of the many other large corporations which have established training organizations to meet their own industrial needs. Industrial requirements are further satisfied by absorbing engineering and technical graduates from State and private universities, where the entire training effort is confined to the class and laboratory work at the universities. Such graduates, however, seldom find their places in industry without first serving supplementary apprenticeships following their graduation from the universities. Such apprenticeships usually run from one to two years. Students at these universities are usually recruited from the graduates of technical high schools.

Finally, it may be said that the educational opportunities in the United States have been extended and developed to that point where, through public, private and corporate schools, a flexible system now obtains which meets the nation's demand for a citizenry well grounded both in the common essentials and those specialized occupational skills or abilities which ensure economic efficiency. (W. F. R.)

EDUCATIONAL ASSOCIATIONS. Many educational and professional associations have been formed since the middle of the 19th century; these have done much to co-ordinate methods of education and to organize the teaching profession as a whole.

GREAT BRITAIN

University teachers of Great Britain are represented by two Associations: The Association of University Teachers (founded 1919) has a membership of 1,200 and publishes The University Bulletin terminally. The Association of University Women Teachers, formed in 1883, has a membership of 2,640, its main objects being to promote the cause of education and to further the professional interests of women teachers

In the sphere of secondary education, there are five important associations: The Head Masters' Conference (founded 1869); membership ([illegible]) is restricted to head masters of public schools and is revised periodically, regard being had to the measure of independence enjoyed by the school's governing body and the head master, and to the number of resident undergraduates at Oxford and Cambridge who have been educated at the school. The Association of Head Mistresses Incorporated (founded 1874); its membership is approximately 600 and its objects are to support and protect the status of women teachers and to safeguard professional and educational interests. The Incorporated Association of Head Masters (founded 1890), mainly represents the interests of publicly controlled secondary schools, with a membership of 500; like the Association of Head Mistresses, it has a wide influence on school administration; it issues a review terminally. The Association of Assistant Mistresses Incorporated was founded in 1884, to promote the discussion of educational questions and to improve professional status side by side with the cause of education; it has a membership of 6,800 drawn from 860 schools. The Incorporated Association of Assistant Masters was founded in 1891; its membership, confined to masters in secondary and public schools, totals over 8,000. It is organized in a central body with 71 branches. Its objects are educational and professional. It publishes a monthly journal, *The A.M.A.*, and a Year Book; it has also issued many memoranda on teaching methods.

The four major secondary associations set up a Joint Committee in 1916 under the title The Joint Committee of the Four Major Secondary Associations. This Committee, when united action is required, speaks with the authority arising from a combined membership of over 15,000 secondary school teachers.

Secondary teachers in Wales are mainly enrolled in one or other of the four major secondary associations, but there is also the Welsh County Schools Association (membership 148) for headmistresses and headmasters; this publishes *The Welsh County Schools Review*.

Two other associations connected with secondary education are The Association of Preparatory Schools, founded in 1892, with a present membership of 700, all of whom are or have been headmasters of preparatory schools, and an official organ *The Preparatory Schools Review;* and the Independent Schools Association, with a membership confined to proprietors; its official publication is *Secondary Education*.

There are three main associations connected with technical education: The Association of Teachers in Technical Institutions was founded in 1904 for the advancement of technical education and the safeguarding of professional interests. It has a membership of 3,700 and issues monthly *The Technical Journal*. The Association of Technical Institutions includes representatives from 102 technical institutes in Great Britain. The Association of Principals in Technical Institutions has 149 members. The Joint Committee of the Four Major Associations, the Association of Teachers in Technical Institutions, and the National Union of Teachers have set up a Joint Committee (Joint Six) with the object of co-ordinating the views of the constituent bodies and taking united action when desirable.

Associations on the administrative side are: The Association of Education Committees representing 260 local education authorities; it publishes a weekly journal, *Education*, and organizes annually the North of England Education Conference. The County Councils' Association and the Association of Municipal Corporations also have education committees in constant relationship with the Association of Education Committees and these bodies have considerable influence with the Board of Education. The Association of Directors and Secretaries for Education has a membership of about 220.

The more important subject associations are: The Classical [illegible], The English Association (6,500—[illegible]), The [illegible] Association (4,400), The Historical Association ([illegible] members—[illegible] local branches). The Mathematical Association ([illegible] members—*Mathematical Gazette*) [illegible] *School Science Review*) and The National Society of Art Masters (800 members). Other subject associations are The Art Teachers Guild, the Educational Handwork Association, the Music Teachers Association and the Secondary Schoolmasters Physical Education Association

Bodies of a more general order include: The Association for Education in Industry and Commerce, The British Association for the Advancement of Science (17 sections including educational science), The British Science Guild, The Civic and Moral Education League, The Education Guild of Great Britain, the New Education Fellowship (2,000—*New Era*, with editions in English French and German), The National Union of Scientific Workers The Parents National Education Union, and the Workers Educational Association (25,000 members, over 2,000 affiliated associations and nearly 600 branches).

Most of the above associations are affiliated to the Annual Conference of Educational Associations presided over by distinguished educationists and first held in 1913. The Conference has supplied a rallying place for teachers and administrators of all categories and its comprehensive organization gives a free platform for full discussion of educational questions from all points of view A full report of the papers and discussions is published yearly. (G. D. D.)

National Union of Teachers.—The National Union of Teachers was constituted in 1870. Its principal objects are to associate and unite the teachers of England and Wales; to provide means for co-operation and the expression of collective opinion upon matters affecting education and the teaching profession; and to secure the establishment of an efficient national system of education. In 1927 the Union achieved a record membership with a total of 125,274 of all types and grades of teachers: university professors, secondary, primary and special school teachers, and fully qualified instructors in handicraft, domestic science and other special subjects.

The controlling body of the Union is an annual conference held at Easter, of about 2,000 delegates, representing 624 local associations which, for the most part, are grouped together in 57 county associations. The executive consists of 37 members, controlling a large official and clerical staff.

The headquarters of the Union are situated at Hamilton House, Mabledon Place, London, and housed in the same building are two other bodies which are independently constituted and governed, yet are integral parts of the Union. The Teachers' Provident Society, with accumulated funds of £3,000,000, and nearly 70,000 members, offers friendly society benefits expressly designed to suit teachers; the benevolent and orphan fund raises about £50,000 annually for charitable purposes. Minor departments are the Union library, its War Aid fund, which raised £250,000 to aid ex-service men or their dependents, and the Thank-offering fund which was raised to augment the pensions of those who retired under pre-war superannuation schemes. The Sustentation or Defence fund has invested funds worth £750,000. The Union publishes its own journal: *The Schoolmaster and Woman Teacher's Chronicle*.

In recent years successful efforts have been made to establish contact and work in co-operation with teachers in other lands for educational progress and international goodwill, and the Union is affiliated both to the World Federation of Education Associations and to the International Federation of Teachers' Associations.

Working in friendly co-operation with the Union are the National Association of Head Teachers and the National Federation of Class Teachers. The first of these organizations includes a large number of head teachers of primary and central schools who are employed in the principal urban centres of the country. Similarly, the National Federation of Class Teachers includes in its membership a considerable number of assistant teachers. Both bodies hold annual conferences at which educational and professional policies are formulated generally in harmony with those proposed by the National Union of Teachers (F W G)

Interna onale des Etud ants [C I E]) was founded a St as bourg n 9 9 th the tr ple ob ect of creat ng fr endship and understanding be ween the university students of the world, of coordinating student activities in all countries, and of studying international questions pertaining to the life of the students so as to foster the broadening of culture and the spread of learning. It is a federation of National Unions, having no direct individual membership, and carrying on its work in complete independence of party politics and sectarian religion. It possesses a membership of over a million.

There are at present 23 full members, eight free members (*i.e.*, Unions which do not represent a majority of the students of their countries, and so have a consultative voice only), one associate member and one association in collaboration. The countries affiliated are Belgium, Bulgaria, Canada, Czechoslovakia, Denmark, England and Wales, Estonia, Finland, France, Georgians abroad, Germany, Holland, Hong-Kong, Hungary, Italy, Latin Americans abroad, Latvia, Luxembourg, New Zealand, Norway, Poland, Rumania, Russian emigrants, Scotland, South Africa, Sweden, Switzerland, Turkey, Ukrainians abroad, United States of America, Uruguay, White Ruthenians abroad, Yugoslavia.

The C.I.E. is governed by a council consisting of five delegates from each National Union and meeting annually in different parts of Europe. This council elects from its members an executive, which meets six times during its two years of office. The detailed work of administration is carried on by various permanent commissions, of which the most important are the central office (Brussels), which controls the internal affairs of the Confederation; the international sports office (Paris); the director of commission office (London); and the international relations and travel office (London) This last is of the utmost importance in the policy of the C.I.E.: its object is to facilitate student travel while increasing its educational value, and it is thus concerned with all the details incident to displacement—reductions in fares and cost of passports and visas, arrangement of intercontinental tours, student hostels, the international student identity card—as well as with international centres for sport and study.

Each national union is responsible for the funds necessary to carry out its own work, and in addition subscribes annually to the confederation on a membership basis.

Publications issued by the C.I.E. include an *Annuaire* in French and English, the *Handbook of Student Travel*, and a *Handbook of Foreign Study for Students*. (I. S. M.)

UNITED STATES

Educational associations of teachers for mutual improvement and for the advancement of the profession were formed very soon after education became an established policy of the United States and a system of training instituted through the interest and vision of such leaders as Horace Mann and Henry Barnard.

The United States has no Federal system of education but does have a distinct American system. It has no governmental authority requiring standard courses of study, teacher training, management, methods or finance as in those countries where education is directed by the central Government. The American system, however, has grown up through the zeal and courage of teachers who have formed local educational associations and overstepped State boundaries to join with their co-workers in conference and in educational investigation. These associations have become clearing houses for educational procedure. Teachers have discussed methods, determined failures and successes, and catalogued educational experiences and results. They have listened to addresses from leaders of the profession and have formed investigating committees until educational methods and standards, materials, processes and attitudes have become greatly unified throughout the States and Territories of the Union.

There are four types of organization common to American teachers: (1) local (generally under the direction of the chief educational officer of the community), (2) county, (3) State and (4) national, and of these types there are general and special divisions. The general association is largely inspirational. In addition, there are those which have to do with the teaching and advancement of special subjects and are more especially technical There is scarcely one of the 2,950 counties of the United States or one of the States and Territories which has not its organization So important are these societies that teachers who are interested in the work they do are urged by their own desire and ambition to attend. Thus, teachers of all groups and subjects find themselves affiliating In most cases, there are divisions, for conference purposes, into kindergarten, primary, rural, grammar and secondary schools, and special subject groups such as social studies, mathematics, language and for the promotion of special or new forms of educational activities.

The most outstanding and influential organization in the United States is The National Education Association, organized at Philadelphia, Pa., in 1857, under the title, The National Teachers' Association. It has held annual meetings since that time. The name was changed in 1870 to The National Educational Association and in 1907, by act of the U.S Congress, the new charter was adopted designating the organization as The National Education Association of the United States. Its general purposes may be considered the objectives of all educational associations in America. "The purpose and object of the incorporation shall be to elevate the character, to advance the interests of the profession of teaching and to promote the cause of education in the United States." It includes the National Council of Education with the following departments and such others as may be created by organization or consolidation: departments of (1) superintendence, (2) normal schools, (3) elementary education, (4) higher education, (5) manual training, (6) art education, (7) kindergarten education, (8) music education, (9) secondary education, (10) business education, (11) child study, (12) physical education, (13) natural science instruction, (14) school administration, (15) library, (16) special education, (17) Indian education. The powers, duties, number and names of these departments of the National Council of Education may be changed or abolished by the corporation.

Membership in the national organization has always been voluntary and general until in 1921 the Delegate Assembly was provided. Educational organizations, State and local, may have representation according to membership in the national body. These representatives participate in the business sessions and in establishing the general policy. However, any teacher or friend of education is eligible to general membership. Under this reorganization, the association undertook to carry its influence and its support to every teacher in the United States. The membership has been extended from a possible 10,000 in 1918 to a registration of 181,000 in 1927, and the attendance is rapidly increasing. There are 1,300 life members. More than 2,500 elementary and high schools have held teachers' meetings during 1927 to consider problems of the profession. This work of the National Association is one of the monumental achievements in education in the United States. The association has been instrumental in aiding local educational administrations in promoting legislation, increasing salaries and promoting research and the general advancement of learning and culture. It has sponsored many of the most forward movements in education. Among them, it has prepared year books which represent the advanced thought on curricula making and educational procedure. Under its direction, the first World Conference on Education was called in San Francisco in 1923, which resulted in the organization of the World Federation of Education Associations which now numbers in its enrolment about 1,000,000 of the 5,000,000 teachers of the world.

In addition to the organizations mentioned, there are 99 other national organizations consisting largely of special interests. They include the American Council of Education, the American Association of Colleges and Universities and organizations for the promotion of almost every conceivable phase of educational life. In addition, there are 30 sectional organizations of New England, Southern States, and Central States. The American Federation of Teachers is a general educational organization which is a branch of the American Federation of Labor. It is a growing concern with gilds in many cities and communities throughout the United States.

...sociations are growing rapidly. Many of them ...ional journals within their States and also have ...eachers engaged in education within the State en...erally no State falls below 60%. In 1908, only ...n State associations; in 1917, there was an en... ...163 out of a possible 900,000.

...ese stand as sponsors for the American public ...undation of American democracy. They believe ... child an opportunity to secure all the education ... of receiving and in making universal education a ... of the free institutions of the United States.

(A. O. T.)

ON IN ANIMALS. In some birds and mam... ...en observed that the young receive parental educa... ...es in its detail in different cases, for it may be ... ...he supplying of a liberating stimulus or an ...ction, while in more complicated expressions the ...nts to careful training in the way in which cer... ...ld be done. It is advantageous in lessening the ...or learning by individual experiment, and in les... ...s of this self-education. Moreover, there is some ...ing-on of the gains of parental experience—a sim...tra-organismal heritage.

...th simple cases, we may notice how a dabchick, ... ones on its back, depresses itself in the stream and ...rm to begin to learn to find their way about in the ... has been seen ducking one of its offspring, as if ... to immersion. The great crested grebe often dives ... carrying the young ones on its back, and they soon ...son. Although young birds do not require to be ...he parents may force or encourage them to make a ...etimes tempting them with food. A guillemot may ... one off the brooding-ledge on to a slope leading ... sea. T. A. Coward notes that "a more usual method ...rd to seize the unfortunate by one wing, and, flying ...il clear of surf and rocks, let it drop." The young ... wings and flutters. It takes its first flight, diagon... ...he sea, where it also takes its first, somewhat com... ...and follows this by beginning to swim. It is waited ...nts or by one of them, and gets some help with ... it is able to fend for itself. There are several ...ell authenticated.

... of education take the form of graduated meals, as ...erved in birds of prey. From prepared pieces of ... with, the nestlings are gradually trained to tackle ...ntact booty. L. J. Hobhouse refers to the expertness ...e young woodpeckers in getting at the seeds of ... he points out that the parent woodpeckers bring ...nes first the seeds themselves, then partly opened ...ally intact ones. "The method of preparing the ... is at least as much a tradition as an instinct." It ... of both teaching and learning.

...mmals the instruction is almost always on the ... The carnivore often brings a living captive to the ...t free in presence of the young ones. This serves ... stimulus to instinctive capacities, but it also affords ... In many cases, *e.g.*, foxes and stoats, the mother ...ring with her on her hunting expeditions, and they ...n their business. The instinctive basis is, of course, ... its exercise under maternal control may continue ... Tregarthen describes circumstantially the detailed ...ns by the mother otter to her cubs. It includes the ... of [illegible] ... kinds ... of [illegible] ... and frog.

... [illegible] ... (See ...)

(J. A. Th.)

red, with his wife and family, took refuge in Normandy, and Edward continued to reside at the Norman court until he was recalled in 1041 by Hardicanute. He appears to have been formally recognized as heir to the throne on the death of Hardicanute in 1042 though his coronation was delayed until Easter 1043. A few months later Edward, in conjunction with the three great earls of the kingdom, made a raid on the queen-mother Aelfgifu, or Emma, and compelled her to live in retirement.

In the earlier years of the reign the influence of Earl Godwine was predominant, though not unopposed. His daughter Edith or Eadgyth became Edward's queen in 1045. But the king's personal tastes inclined much more to foreigners than to Englishmen, and he fell more and more into the hands of foreign favourites Between Godwine, representing the spirit of nationalism, and these favourites (especially Robert of Jumièges) there was war to the knife. In 1046 Magnus, king of Norway, who had succeeded Hardicanute in Denmark and claimed to succeed him in England as well, threatened an invasion, but the necessity of defending Denmark against his rival Sweyn Estrithson prevented him from carrying it into effect. In 1049, Godwine's son Sweyn, who had been outlawed for the seduction of the abbess of Leominster, returned and demanded his restoration. This was refused and Sweyn returned into exile, but not before he had murdered his young kinsman Beorn. He was, however, inlawed next year. The influence of Godwine, already shaken, received a severe blow in 1051 in the appointment of Robert of Jumièges to the archbishopric of Canterbury, and the same year saw the triumph of the foreigners for the moment complete. Edward, indignant at the resistance offered by the men of Dover to the insolence of his brother-in-law Eustace of Boulogne and his French followers ordered Godwine to punish the town. Godwine refused. The king at the prompting of the archbishop then summoned a meeting of the witan, at which the old charge against Godwine of complicity in the murder of the Aetheling Alfred was to be revived About the same time came news of a fresh outrage by the foreigners. Godwine gathered his forces and demanded redress, while the earls Leofric of Mercia and Siward of Northumbria hastened to the side of the king. Civil war seemed imminent, but at length the matter was referred to a meeting of the witan to be held at London. At the appointed time Godwine presented himself at Southwark, but his followers were rapidly deserting him and he fled to Flanders, while his son Harold went to Ireland But the tale of Godwine excited universal sympathy, for he represented the cause of national independence. Encouraged by assurances from England, he sailed thither, and joining forces with Harold sailed along the south coast and up the Thames. The king would have resisted, but found no support. He allowed himself to be reconciled, and Godwine and his house were restored to their old position. The queen at the same time was brought back from the monastery of Wherwell, whither she had been despatched after her father's flight.

The foreigners had already ignominiously fled the country, and henceforth the influence of Godwine, and, after his death, of Harold, was supreme. In 1063 Harold made a great expedition into Wales, in which he crushed the power of King Gruffyd. But he was the minister of the king rather than his personal favourite This latter position belonged to his younger brother Tostig, earl of Northumbria. In 1065 Tostig's subjects broke into revolt They elected Morkere as their earl, then marching south demanded Tostig's banishment. Edward desired to crush the revolt by force of arms, but he was overborne and forced to submit. The election of Morkere was recognized, and Tostig went into exile. Intensely mortified at this humiliation, the king fell sick, and henceforth his health failed rapidly. He was unable to be present at the consecration of his new abbey of Westminster, the foundation of which had been the chief [illegible] of his closing years and on Jan 5 1066 he died.

The [illegible] of [illegible] were monkish rather than kingly Al... [illegible]

which had not attached to it in life.

BIBLIOGRAPHY.—A number of lives of Edward are brought together in a volume of the Rolls Series entitled *Lives of Edward the Confessor*, ed. Dr. H. R. Luard (1858). Of these the most valuable is the contemporary *Vita Edwardi*, which would appear from internal evidence to have been written by an unknown writer soon after the Norman Conquest—some time between 1066 and 1074. The other chief authorities for the reign are (1) the *Saxon Chronicle* (C. Plummer, Oxford, 1892–99); (2) *Florence of Worcester*, ed. B. Thorpe, English Historical Society (1848–49). Reference may also be made to J. M. Kemble, *Codex diplomaticus aevi Saxonici* (London, 1839–48). (C. S. P.)

EDWARD, "THE ELDER" (d. 924), king of the Angles and Saxons, was the second son of Alfred the Great, and with his sister Aethelflaed was educated at the court of his father. He took part in the campaigns against the Danes, especially in that of 894, and as early as 898 he signs a charter as "rex," showing that he was definitely associated with his father in the kingship. He succeeded his father in Oct. 899, but not without opposition. The Aetheling Aethelwold, son of Alfred's elder brother Aethelred, seized Wimborne and Christchurch. Edward advanced against him, and Aethelwold took refuge among the Danes in Northumbria. In 904 Aethelwold landed in Essex, and in the next year he enticed the East Anglian Danes to revolt. They ravaged all southern Mercia and returned home victorious, though Aethelwold fell in the battle of the Holme. In 905 or 906 Edward made a peace with the East Anglian and Northumbrian Danes at "Yttingaford," near Linslade in Buckinghamshire, perhaps the peace known as "the Laws of Edward and Guthrum." In 909 and 910 fresh victories were won against the invading Danes at Tettenhall and Wednesfield in Staffordshire. From 907 onwards Edward and his sister Aethelflaed, the Lady of the Mercians, were busy strengthening their hold on Mercia and Wessex. Forts were built at Lincoln (907), "Bremesbyrig" (910), "Scergeat" and Bridgenorth (912), and when in the year 911 Aethelflaed's husband Aethelred died, Edward took over from Mercia the government of London and Oxford, with the lands belonging to them, *i.e.*, probably Oxfordshire and Middlesex. Hertford was fortified in 911, Witham in 912, while Aethelflaed fortified Cherbury in Shropshire, "Weardbyrig" and Runcorn (all in 915). In 913 the Danes in Eastern Mercia gave considerable trouble, and in 914 a fresh horde of pirates, coming from Brittany, raided southern Wales, but were besieged by the English forces until they promised to leave the king's territory. The Danes failed to secure a hold in the Bristol channel and were ultimately forced to sail to Ireland. In the same year Edward fortified Buckingham and received the submission of the jarls and chief men of Bedford. In 915 he fortified Bedford, Maldon in 916, and Towcester and "Wigingamere" in 917. In 917 Edward also captured Tempsford and Colchester. An attack by the Danes on Maldon failed, and in 915 Edward went to Passenham and received the submission of the men of the "borough" of Northampton. The Danish strongholds of Huntingdon and Colchester were now restored and repaired, and Edward received the submission of the whole of the East Anglian Danes. Before midsummer of this year Edward had fortified Stamford, and on the death of his sister he received the submission of the Mercians at Tamworth. There also three kings of the North Welsh took Edward as their lord. Nottingham was now fortified; Thelwall in Cheshire (919) and Manchester soon followed; Nottingham was strengthened by a second fort; Bakewell was fortified and garrisoned, and then came the greatest triumph of Edward's reign. He was "chosen as father and lord" by the Scottish king and nation, by Raegenald, the Norwegian king of Northumbria, by Ealdred of Bamborough, and by the English, Danes or Norwegians in Northumbria, and by the Strathclyde Welsh.

With the conclusion of his wars Edward's activity ceased, and we hear no more of him until in 924 he died at Farndon in Cheshire and was buried in the "New Minster" at Winchester. He was thrice married: (1) to Ecgwyn, a lady of rank, by whom he had a son Aethelstan, who succeeded him, and a daughter Eadgyth, who married Sihtric of Northumbria in 924. This marriage was probably an irregular one. (2) To Aelflaed, by whom he had two sons—Aelfweard, who died a fortnight after his father, and Eadwine, who was drowned in 933—and six daughters, Aethelflaed and Aethelhild, nuns, and four others (*see* AETHELSTAN). (3) To Eadgifu, the mother of Kings Edmund and Edred, and of two daughters.

See the *Anglo-Saxon Chronicle* (ed. Plummer, 1892–99), Florence of Worcester (*Mon. Hist. Brit.*); William of Malmesbury, *Gesta regum* (Rolls Series); Simeon of Durham (Rolls Series); Ethelweard (*Mon Hist. Brit.*); Birch, *Cartularium Saxonicum*, Nos. 588–635; *D.N.B.*, s.v. (A. M.)

EDWARD, "THE MARTYR" (*c.* 963–978), king of the English, was the son of Edgar by his first wife Aethelflaed. Edgar's second wife Aelfthryth desired to obtain the crown for her son Aethelred, but Dunstan upheld Edward's claim, and he was crowned at Kingston in 975. Edward's brief reign was marked by an anti-monastic reaction. There seems also to have been an attempt to bring the Danes into more direct dependence on the crown by the banishment of Oslac, earl of Northumbria. In ecclesiastical matters there were two parties in the kingdom, the monastic, which had its chief hold in Essex and East Anglia, and the anti-monastic, led by Aelfhere of Mercia, who expelled many of the monks whom Aethelwold had installed. Conferences were held at Kirtlington in Oxfordshire and at Calne in Wiltshire in 977 and 978, but nothing definite seems to have been decided. On March 18, 978, Edward was assassinated at Corfe castle in Dorsetshire. The crime was probably inspired by his stepmother, Aelfthryth, who was anxious to secure the succession of her son Aethelred. The body was hastily interred at Wareham and remained there till 980, when Archbishop Dunstan and Aelfhere of Mercia transferred it with great ceremony to Shaftesbury. Very shortly after his death he was popularly esteemed to be both saint and martyr.

See *Saxon Chronicle*; *Vita S. Oswaldi* (*Hist. of Ch. of York*, Rolls Series); *Memorials of St. Dunstan* (ed. Stubbs, Rolls Series).

EDWARD I. (1239–1307), king of England, born at Westminster on June 17 1239, was the eldest son of Henry III. and Eleanor of Provence. He was baptized Edward after Edward the Confessor, for whom Henry had special veneration, and among his godfathers was Simon de Montfort, earl of Leicester, his aunt Eleanor's husband. His political career begins when the conclusion of a treaty with Alphonso X. of Castile, by which he was to marry the Spanish king's half sister Eleanor, necessitated the conferring on him of an adequate establishment. His father granted him the duchy of Gascony, the earldom of Chester, the king's lands in Wales and much else.

The Prince.—In May 1254 Edward went to Gascony to take possession of his inheritance. He then crossed the Pyrenees, and in October was dubbed knight by Alphonso and married to Eleanor at the Cistercian convent of Las Huelgas, near Burgos. He remained in Gascony till November 1255, but his father was too jealous to allow him a free hand in its administration. After his return, the attempts of his agents to establish English laws in his Welsh possessions brought Edward into hostile relations with the Welsh. Here also his father would give him no help, and his first campaign brought him little result. Edward became extremely unpopular through his association with his Lusignan kinsfolk, his pride and violence, and the disorders of his household. In 1258 his strenuous opposition to the Provisions of Oxford further weakened his position, but, after the banishment of the foreigners, he began to take up a wiser line.

In 1259 he led the young nobles who insisted that the triumphant oligarchy should carry out the reforms to which it was pledged. For a moment it looked as if Edward and Leicester might make common cause, but Edward remained an enemy of Montfort, though he strove to infuse his father's party with a more liberal and national spirit. He was the soul of the reconstituted royalist party formed about 1263. In 1264 he took a prominent part in the fighting between the king and the barons. At the battle of Lewes his rash pursuit of the Londoners contributed to his father's defeat. Two days later Edward surrendered to Leicester as a hostage for the good behaviour of his allies. He was forced to give up his earldom of Chester to Leicester, but at Whitsuntide 1265 he escaped from his custodians, and joined the lords of the Welsh march who were still in arms. With their aid he defeated and slew Leicester at Evesham on Aug 4, 1265.

of the reign of Henry III.'s reign Edward controlled his father's policy and appropriated enough of Leicester's ideals to make the royalist restoration no mere reaction. So peaceful became the outlook of affairs that in 1268 Edward took the cross, hoping to join the new crusade of St. Louis. Want of money delayed his departure till 1270, by which time St. Louis was dead, and a truce concluded with the infidels. Refusing to be a party to such treason to Christendom, Edward went with his personal followers to Acre, where he abode from May 1271 to August 1272. Despite his energy and valour he could do little to prop up the decaying crusading kingdom and he narrowly escaped assassination. The declining health of his father induced him to return to the West.

He learned in Sicily the death of Henry III. on Nov. 16, 1272. On Nov. 20 the day of Henry's funeral, he was recognized as king by the English barons. Edward did not hurry home. After a slow journey through Italy and France he did homage to his cousin Philip III. at Paris on July 26, 1273. He then went to Gascony, where he stayed nearly a year. He landed at Dover on Aug. 2, 1274, and was crowned at Westminster on Aug. 18th.

Character and Administration.—Edward was 35 years old when he became king, and the rude schooling of his youth had developed his character and suggested the main lines of the policy which he was to carry out as monarch. He was a tall, well-proportioned and handsome man, extravagantly devoted to military exercises, tournaments and the rougher and more dangerous forms of hunting. He had learned to restrain the hot temper of his youth, and was proud of his love of justice and strict regard to his plighted word. His domestic life was unstained, he was devoted to his friends, and loyal to his subordinates. Without any great originality either as soldier or statesman, he was competent enough to appropriate the best ideas of the time and make them his own. His defects were a hardness of disposition which sometimes approached cruelty and a narrow and pedantic temper, which caused him to regard the letter rather than the spirit of his promises. His effectiveness and love of strong government stand in strong contrast to his father's weakness. Though he loved power, and never willingly surrendered it, he saw that to be successful he must make his policy popular. Thus he continued the system which Montfort had formed with the object of restraining the monarchy, because he saw in a close alliance with his people the best means of consolidating the power of the crown.

The first years of Edward's reign were mainly occupied by his efforts to establish a really effective administration. In carrying out this task he derived great help from his chancellor, Robert Burnell, bishop of Bath and Wells. From 1275 to 1290 nearly every year was marked by an important law. Few of these contained anything that was very new or original. They rather illustrate that policy which caused Stubbs to describe his reign as a "period of definition." Yet the results of his conservative legislation were almost revolutionary. In particular he left the impress of his policy on the land laws of England, notably by the clause *De Donis* of the Westminster statute of 1285, and the statute *Quia Emptores* of 1290. The general effect of his work was to eliminate feudalism from political life. At first he aimed at abolishing all franchises whose holders could not produce written warranty for them. This was the policy of the statute of Gloucester of 1278, but the baronial opposition was so resolute that Edward was forced to permit many immunities to remain. Though the most orthodox of churchmen, his dislike of authority not emanating from himself threatened to involve him in constant conflict with the Church, and notably with John Peckham, the Franciscan friar, who was archbishop of Canterbury from 1279 to 1292. The statute of Mortmain of 1279, which forbade the further grant of lands to ecclesiastical corporations without the royal consent, and the writ *Circumspecte Agatis* of 1285, which limited the church courts to strictly ecclesiastical business, both provoked strong clerical opposition. However, Peckham gave way to some extent, and Edward prudently acquiesced in many clerical assumptions which he disliked. He was strong enough to refuse to pay the tribute to Rome which John had promised, and his reign saw the end of that papal overlordship over England which had greatly complicated the situation under his father.

WELSH, SCOTTISH AND PARLIAMENTARY POLICIES

Wales.—Besides administration and legislation, the other great event of the first 15 years of Edward's reign was the conquest of the principality of Wales. It was part of Edward's policy of reconciliation after the battle of Evesham that in the treaty of Shrewsbury of 1267 he had fully recognized the great position which Llewelyn ab Gruffyd, prince of Wales, had gained as the ally of Simon de Montfort. However, Llewelyn's early successes had blinded the Welsh prince to the limitations of his power, and he profited by Edward's early absences from England to delay in performing his feudal obligations to the new king. Even after Edward's return Llewelyn continued to evade doing homage. At last Edward lost patience, and in 1277 invaded north Wales. He conducted his campaign like a great siege, blocking all the avenues to Snowdon, and forcing Llewelyn to surrender from lack of supplies. He thereupon reduced the Welsh prince to the position of a petty north Welsh chieftain strictly dependent on the English.

For the next five years Edward did his best to set up the English system of government in the ceded districts. The Welsh resentment of this soon gave Llewelyn another chance, and compelled Edward to devote the years 1282–83 to completing his conquest. In 1284 he issued the statute of Wales, which provided for a scheme for the future government of the principality. Edward is often called the conqueror of Wales, but in truth he only effected the conquest of Llewelyn's dominions. The march of Wales was only indirectly affected by his legislation, and remained subject to its feudal marcher lords until the 16th century

Foreign Policy.—Though preserving nominal peace with his cousin Philip III. of France, his relations with that country were constantly strained. After Philip III.'s death in 1285, Edward crossed the Channel in 1286, to perform homage to his successor, Philip the Fair. He remained abroad till 1289, busied in attempts to improve the administration of Gascony, and making repeated and finally successful efforts to end by his mediation the still continuing struggle between the houses of Anjou and Aragon. His long absence threw the government of England into confusion, and on his return in 1289 he was compelled to dismiss most of his judges and ministers for corruption. In 1290 he expelled all Jews from England.

The affairs of Scotland furnished Edward with his chief preoccupation for the rest of his reign. After the death of Alexander III., in 1286, Scotland was governed in the name of his granddaughter Margaret, the Maid of Norway. The English king had suggested that Edward of Carnarvon, his eldest surviving son, should marry the little queen of Scots, and thus bring about the union of the two countries. However, the death of Margaret in 1290 frustrated the scheme. The Scottish throne was now disputed by many claimants, and the Scots asked Edward to arbitrate between them. Edward accepted the position, but insisted that, before he acted, the Scots should recognize him as their overlord. The claimants set the example of submission, and soon the chief Scots nobles followed. Thereupon Edward undertook the arbitration, and in 1292 adjudged the throne to John Baliol. The new king did homage to Edward, but his subjects soon began to resent the claims of jurisdiction over Scotland, which Edward declared were the natural results of his feudal supremacy. At last the Scots deprived John of nearly all his power, repudiated Edward's claims, and made an alliance with the French.

During the years of the Scottish arbitration Edward had slowly been drifting into war with France. The chronic difficulties caused by French attempts to confine Edward's power in Gascony were now accentuated by the quarrels between the sailors and merchants of the two countries. In 1293 Edward was persuaded by his brother, Edmund, earl of Lancaster, to yield up Gascony temporarily to Philip the Fair. But Philip refused to restore the duchy, and Edward, seeing that he had been tricked, declared war against France, at the very moment when the Scottish resistance gave the French a firm ally in Britain. To make matters worse, the Welsh rose in rebellion. It was therefore quite impossible for Edward to recover Gascony.

The Model Parliament.—The most critical years of Edward's

reign now began. He saw that he could only meet his difficulties by throwing himself on the support of his own subjects, and on asked in 1295 a representative parliament of the three estates, which has been called in later times the Model Parliament, because it first illustrated the type which was to be perpetuated in all subsequent parliaments. "What touches all," ran Edward's writ of summons, "should be approved of all, and it is also clear that common dangers should be met by measures agreed upon in common." The parliamentary constitution of England was established as the result of Edward's action.

Secure of his subjects' allegiance, Edward put down the Welsh revolt, and conquered Scotland in 1296. When quiet was restored to Britain, he hoped to throw all his energy into the recovery of Gascony, but new troubles arose at home which once more diverted him from his supreme purpose. Led by Archbishop Winchelsea, Peckham's successor, the clergy refused to pay taxes in obedience to the bull of Pope Boniface VIII., called *Clericis Laicos*. Edward declared that if the clergy would not contribute to support the state, the state could afford them no protection.

But the clerical opposition was soon joined by a baronial opposition. Headed by the earls of Hereford and Norfolk, many of the barons declined to join in an expedition to Gascony, and Edward was forced to sail to the French war, leaving them behind. Thereupon the recalcitrant barons forced upon the regency a fresh confirmation of the charters, to which new articles were added, safeguarding the people from arbitrary taxation. Edward at Ghent reluctantly accepted this *Confirmatio Cartarum*, but even his submission did not end the crisis.

Wallace.—In the same year (1297), all Scotland rose in revolt under the popular hero William Wallace, and next year (1298), Edward was forced to undertake its reconquest. The battle of Falkirk, won on July 22, was the greatest of Edward's military triumphs; but, though it destroyed the power of Wallace, it did not put an end to Scottish resistance. Bitter experience taught Edward that he could not fight the French and the Scots at the same time, and in 1299 he made peace with Philip, and, Eleanor having died in November 1290, he married the French king's sister Margaret (*c.* 1282–1318), and some years later obtained the restitution of Gascony. In the same spirit he strove to destroy the clerical and baronial opposition. He did not succeed in the former task until a complacent pope arose in his own subject, Clement V., who abandoned Winchelsea to his anger, and suffered the archbishop to be driven into exile. The baronial leaders could not be wholly overthrown by force, and Edward was compelled to make them fresh concessions.

Bruce.—It was not until 1303 that Edward was able to undertake seriously the conquest of Scotland. By 1305 the land was subdued, and Wallace beheaded as a traitor. But Edward had hardly organized the government of his new conquest when a fresh revolt broke out under Robert Bruce, grandson of the chief rival of Baliol in 1290. Bruce was soon crowned king of Scots, and at the age of 70 Edward had to face the prospect of conquering Scotland for the third time. He resolved to take the field in person; but the effort was too great, and on July 7, 1307 he died at Burgh-on-Sands, near Carlisle. His death destroyed the last faint hope of conquering Scotland, and showed that the chief ambition of his life was a failure. Yet his conquest of Wales, his legislation, his triumph over his barons, his ecclesiastics, and the greatest of French mediaeval kings indicate the strength and permanence of his work. He was buried at Westminster under a plain slab on which was inscribed *Edwardus primus Scottorum malleus hic est. Pactum serva.*

By Eleanor of Castile Edward had four sons, his successor Edward II. and three who died young, and nine daughters, including Joan, or Joanna (1272–1307), the wife of Gilbert de Clare, earl of Gloucester (d. 1295), and then of Ralph de Monthermer; Margaret (1275–1318), the wife of John II., duke of Brabant; and Eleanor (1282–1316), who married John I., count of Holland, and then Humphrey Bohun, earl of Hereford (d. 1322). By Margaret of France the king had two sons: Thomas of Brotherton, earl of Norfolk, and Edmund of Woodstock, earl of Kent.

The principal modern authorities for this reign are: W. Stubbs, *Constitutional History of England*, chap. xv. and xv. (1896), T. F. Tout *Edward I.* (1895), and *Political History of England, 1216–1377*, pp. 136–235 (1905); R. B. Seeley, *Life and Reign of Edward I* (1872); R. Pauli, *Geschichte von England*, iv. pp. 1–198 (Hamburg 1864–75); W. Hunt, article on "Edward I." in *Dictionary of National Biography*; J. E. Morris, *Welsh Wars of Edward I.* (Oxford, 1901), and C. V. Langlois, *Philippe le Hardi* (Paris, 1887). (T. F. T.)

EDWARD II. (1284–1327), "of Carnarvon," king of England, the fourth son of Edward I. by his first wife Eleanor of Castile, was born at Carnarvon castle on April 25, 1284. The story that the king presented the new-born child to the Welsh as their future native prince is quite unfounded, for Edward was only made prince of Wales in the Lincoln parliament of 1301. When a few months old, he became by his elder brother's death the heir to the throne, and Edward I. took great pains to train him in warfare and statecraft. He took part in several Scots campaigns, but all his father's efforts could not prevent his acquiring the habits of extravagance and frivolity which he retained all through his life. The old king attributed his son's defects to the bad influence of his friend, the Gascon knight Piers Gaveston, and drove the favourite into exile. When Edward I. died, on July 7, 1307, the first act of the prince, now Edward II., was to recall Gaveston. His next was to abandon the Scots campaign on which his father had set his heart.

The new king was physically almost as fine a man as Edward I. He was, however, destitute of any serious purpose, and was, as Dr. Stubbs says, "the first king after the Conquest who was not a man of business." He cared for nothing but amusing himself, and found his chief delight in athletics and in the practice of mechanical crafts. He was not so much vicious as foolish, and wanting in all serious interests. He had so little confidence in himself that he was always in the hands of some favourite who possessed a stronger will than his own. In the early years of his reign Gaveston held this rôle, acting as regent when Edward went to France—where, on Jan. 25, 1308, he married Isabella, the daughter of Philip the Fair—and receiving the earldom of Cornwall with the hand of the king's niece, Margaret of Gloucester. The barons soon grew indignant at Edward's devotion to his "brother Piers," and twice insisted on his banishment. On each occasion Edward soon recalled his friend, whereupon the barons, headed by the king's cousin Thomas, earl of Lancaster, went to war against king and favourite, and in 1312 treacherously put Gaveston to death. Edward was forced to stand aside and suffer the realm to be governed by the baronial committee of 21 lords ordainers, who, in 1311, had drawn up a series of ordinances, whose effect was to substitute ordainers for the king as the effective government of the country. But in all the ordinances nothing was said about the commons and lower clergy. Parliament meant to the new rulers an assembly of barons just as it had done to the opponents of Henry III. in 1258. The effect of their triumph was to change England from a monarchy to a narrow oligarchy.

During the quarrels between Edward and the ordainers, Robert Bruce was steadily conquering Scotland. His progress was so great that he had occupied all the fortresses save Stirling, which he closely besieged. The danger of losing Stirling shamed Edward and the barons into an attempt to retrieve their lost ground. In June 1314 Edward led a great army into Scotland in the hope of relieving Stirling. On June 24, his ill-disciplined and badly led host was completely defeated by Robert Bruce at Bannockburn. Edward's disgraceful defeat made him more dependent on his barons than ever. His kinsman, Thomas of Lancaster had shown some capacity as a leader of opposition, but though he had great wealth, and was lord of five earldoms, he had small ability and no constructive power. In his desire to keep the king weak, he was suspected to have made a secret understanding with Robert Bruce. Before long the opposition split up under his incompetent guidance into fiercely contending factions. Under Aymer of Valence, earl of Pembroke, a middle party arose, which hated Lancaster so much that it supported the king to put an end to Lancaster's rule. After 1318 the effect of its influence was to restore Edward to some portion of his authority. However, the king hated Pembroke almost as much as Lancaster. He now found

...ompetent adviser in Hugh le Despenser, a baron of great ...perience. What was more important to him, he had in Despen...'s son Hugh le Despenser the younger, a personal friend and ...ourite who was able in some measure to replace Gaveston. ...e fierce hatred which the barons manifested to the Despensers ...owed that they could hate a deserter as bitterly as they had ...ted the Gascon adventurer. They were indignant at the favours ...ich Edward lavished upon the favourite and his father, and ...re especially alarmed when the younger Despenser strove ...procure for himself the earldom of Gloucester in right of his ...fe, Edward's niece.

At last, in 1321, the barons met in parliament, and under ...ncaster's guidance procured the banishment of the Despensers. ...e disasters of his friends inspired Edward to unwonted activity. ...1322 he recalled them from exile, and waged war against ...barons on their behalf. Triumph crowned his exertions. Lan...ter, defeated at Boroughbridge, was executed at Pontefract. ...r the next five years the Despensers ruled England. Unlike ...ordainers, they took pains to get the Commons on their side, ...d a parliament held at York in 1322 revoked the ordinances ...ause they trenched upon the rights of the crown, and were ...wn up by the barons only. From this time no statute was ...hnically valid unless the Commons had agreed to it. This ...rks the most important step forward in Edward II.'s reign. ...t the rule of the Despensers soon fell away from this wise be...ning. They thought only of heaping up wealth for themselves, ...d soon stirred up universal indignation. In particular, they ...ited the ill-will of the queen, Isabella of France. Craftily ...embling her indignation, Isabella kept silence until 1325, when ...went to France in company with her eldest son, Edward of ...ndsor, who was sent to do homage for Aquitaine to her brother, ...new French king. When her business was over, Isabella de...ed to return to her husband as long as the Despensers re...ned his favourites. She formed a criminal connection with ...ger Mortimer of Wigmore, one of the baronial exiles, and in ...tember 1326 landed in Essex accompanied by Mortimer and ...son, declaring that she was come to avenge the murder of ...ncaster, and to expel the Despensers. Edward's followers de...ed him, and on Oct. 2, he fled from London to the west, where ...took refuge in the younger Despenser's estates in Glamorgan. ...wife followed him, put to death both the Despensers, and, ...er a futile effort to escape by sea, Edward was captured on ...v. 16. He was imprisoned at Kenilworth castle, and a parlia...nt met at Westminster in January 1327, which chose his son to ...king as Edward III. It was thought prudent to compel the ...tive king to resign the crown, and on Jan. 20, Edward was ...ced to renounce his office before a committee of the estates. ...e government of Isabella and Mortimer was so weakly estab...ed that it dared not leave the deposed king alive. On April 3, ...was secretly removed from Kenilworth and entrusted to the ...tody of two dependants of Mortimer. After various wander...s he was imprisoned at Berkeley castle in Gloucestershire. ...ery indignity was inflicted upon him, and he was systematically ...treated in the hope that he would die of disease. When his ...ng constitution seemed likely to prevail over the ill-treatment ...his enemies he was cruelly put to death on Sept. 21. It was ...ounced that he had died a natural death, and he was buried in ...Peter's abbey at Gloucester, now the cathedral, where his ...t afterwards erected a magnificent tomb.

Edward's wife, Isabella (c. 1292–1358), bore him two sons, ...ward III. and John of Eltham, earl of Cornwall (1316–36), ...d two daughters, Isabella and Joanna (1321–62), wife of David ...king of Scotland. After the execution of her paramour, Roger ...rtimer, in 1330, Isabella retired from public life; she died at ...rtford on Aug. 22, 1358.

...e R. Pauli, Geschichte von England, iv. [illegible]; T. F. Tout, [illegible] article in ...ictionary of National Biography; W. Stubbs, Constitutional History, [illegible] Introductions to Chronicles of the Reigns of ...ward I and Edward II, in Rolls series; J. C. Davies, Baronial [illegible] (1918); Selden Society, Year Books of Edward ... d'Inghilterra all' Abbazia di S. Alberto di Butrio (1924). (T. F. T.)

EDWARD III. (1312–1377), "of Windsor," king of England, eldest son of Edward II. and Isabella of France, was born at Windsor on Nov. 13, 1312. In 1320 he was made earl of Chester and in 1325 duke of Aquitaine, but he never received the title of prince of Wales. Immediately after his appointment to Aquitaine he was sent to France to do homage to his uncle Charles IV, and remained abroad until he accompanied his mother and Mortimer in their expedition to England. To raise funds for this he was betrothed to Philippa, daughter of the count of Hainaut. On Oct. 26, 1326, after the fall of Bristol, he was proclaimed warden of the kingdom during his father's absence. On Jan. 13, 1327, parliament recognized him as king, and he was crowned on the 29th of the same month.

For the next four years Isabella and Mortimer governed in his name, though nominally his guardian was Henry, earl of Lancaster. In the summer he took part in an abortive campaign against the Scots, and was married to Philippa at York on Jan. 24, 1328. On June 15, 1330, his eldest child, Edward, the Black Prince, was born. Soon after, Edward made a successful effort to throw off his degrading dependence on his mother and Mortimer. In Oct. 1330 he entered Nottingham Castle by night, through a subterranean passage, and took Mortimer prisoner. On Nov. 29, the execution of the favourite at Tyburn completed the young king's emancipation. Edward ignored his mother's relations with Mortimer, and treated her with every respect.

Edward III.'s real reign now begins. Young, ardent and active, he strove with all his might to win back for England something of the position which it had acquired under Edward I. He resented the concession of independence to Scotland by the Treaty of Northampton of 1328, and the death of Robert Bruce in 1329 gave him a chance of retrieving his position. The new king of Scots, David, who was his brother-in-law, was a mere boy, and the Scottish barons, exiled for their support of Robert Bruce, took advantage of the weakness of his rule to invade Scotland in 1332. At their head was Edward Baliol, whose victory at Dupplin Moor established him for a brief time as king of Scots. After four months Baliol was driven out by the Scots, whereupon Edward for the first time openly took up his cause. In 1333 the king won in person the battle of Halidon Hill over the Scots, but his victory did not restore Baliol to power. The Scots despised him as a puppet of the English king, and after a few years David was finally established in Scotland. During these years England gradually drifted into hostility with France. The chief cause of this was the impossible situation which resulted from Edward's position as duke of Gascony. Contributing causes were Philip's support of the Scots and Edward's alliance with the Flemish cities, which were then on bad terms with their French overlord, and the revival of Edward's claim, first made in 1328, to the French crown. War broke out in 1337, and in 1338 Edward visited Coblenz, where he made an alliance with the emperor Louis the Bavarian. In 1339 and 1340 Edward endeavoured to invade France from the north with the help of his German and Flemish allies, but the only result of his campaigns was to reduce him to bankruptcy.

In 1340, however, he took personal part in the great naval battle off Sluys, in which he destroyed the French navy. In the same year he assumed the title of king of France. At first he did this to gratify the Flemings, whose scruples in fighting their overlord, the French king, disappeared when they persuaded themselves that Edward was the rightful king of France. The persistence with which he and his successors urged their pretensions to the French crown made stable peace impossible for more than a century, and led to the Hundred Years' War. Till the days of George III. every English king also called himself king of France.

Despite his victory at Sluys, Edward was forced before the end of 1340 to make a truce and return to England. He blamed his chief minister Archbishop Stratford for his financial distress and immediately on his return vindictively attacked him. Before the truce expired a disputed [illegible]

He was back in England in 1343. He spent much time and money in rebuilding Windsor castle and instituting the order of the Garter, in fulfilment of a vow that he had taken to restore the Round Table of Arthur. His finances, therefore, remained embarrassed, although in 1339 he had repudiated his debt to his Italian creditors. A new phase of the French war begins when in July 1346 Edward landed in Normandy, accompanied by his eldest son, Edward, prince of Wales, a youth of 16. Edward marched from La Hogue to Caen, and from Caen almost to the gates of Paris. It was a plundering expedition on a large scale, and like most of Edward's campaigns showed some want of strategic purpose. But Edward's decisive victory over the French at Crécy, in Ponthieu, on Aug. 26, where he scattered the army with which Philip VI. attempted to stay his retreat from Paris to the northern frontier, signally demonstrated the tactical superiority of Edward's army over the French. Next year Edward effected the reduction of Calais. This was the most solid and lasting of his conquests, and its execution compelled him to greater efforts than the Crécy campaign. Other victories in Gascony and Brittany followed. In 1346, David, king of Scots, was also defeated and taken prisoner at Neville's Cross, near Durham. Want of money forced Edward to make a new truce in 1347. He was as far from the conquest of France as ever.

Edward returned to England in Oct. 1347. He celebrated his triumph by a series of splendid tournaments, and completed his scheme for the establishment of the Order of the Garter. In 1348 he rejected an offer of the imperial throne. In the same year the Black Death first appeared in England, and raged until 1349. Its horrors hardly checked the magnificent revels of Edward's court, and neither the plague nor the truce stayed the slow course of the French war. Edward's martial exploits during the next years were those of a gallant knight rather than of a responsible general. Conspicuous among them were his famous combat with Eustace de Ribemont, near Calais, in 1349, and the hard-fought naval victory over the Spaniards off Winchelsea, in 1350. Efforts to make peace, initiated by Pope Innocent VI., came to nothing, though the English Commons were now weary of the war. The result of this failure was the renewal of war on a large scale. In 1355 Edward led an unsuccessful raid out of Calais, and in Jan. and Feb. 1356 harried the Lothians, in the expedition famous as the Burned Candlemas. His exploits were eclipsed by those of his son, whose victory at Poitiers, on Sept. 19, 1356, resulted in the captivity of King John, and forced the French to accept a new truce. Edward entertained his captive magnificently, and in 1359 concluded with him the Treaty of London, by which John surrendered so much that the French repudiated the treaty. Edward thereupon resolved to invade France afresh and compel its acceptance. On Oct. 28 he landed at Calais, and advanced to Reims, where he hoped to be crowned king of France. The strenuous resistance of the citizens frustrated this scheme, and Edward marched into Burgundy, whence he made his way back towards Paris. Failing in an attack on the capital, he was glad to conclude, on May 8, 1360, preliminaries of peace at Brétigny, near Chartres. This treaty, less onerous to France than that of London, took its final form in the Treaty of Calais, ratified by King John on Oct. 9. By it Edward renounced his claim to France in return for the whole of Aquitaine.

The Treaty of Calais did not bring rest or prosperity either to England or France. Fresh visitations of the Black Death, in 1362 and 1369, intensified the social and economic disturbances which had begun with the first outbreak in 1348. Desperate, but not very successful, efforts were made to enforce the Statute of Labourers, of 1351, by which it was sought to maintain prices and wages as they had been before the pestilence. Another feature of these years was the anti-papal, or rather anti-clerical, legislation embodied in the statutes of Provisors and Praemunire. These measures were first passed in 1351 and 1353, but often repeated. In 1366 Edward formally repudiated the feudal supremacy over England, still claimed by the papacy by reason of John's submission. Another feature of the time was the strenuous effort made by Edward to establish his numerous family without too great expense. In the end the estates of the houses of Lancaster, Kent, Bohun, Burgh and Mortimer swelled the revenues of Edward's children and grandchildren, in whose favour also the new title of duke was introduced.

In 1369 the French king, Charles V., repudiated the Treaty of Calais and renewed the war. Edward's French dominions gladly reverted to their old allegiance. Edward resumed the title and arms of king of France, but left most of the fighting and administration of his foreign kingdoms to his sons, Edward and John. Meanwhile, Edward attacked the wealth and privileges of the Church. In 1371 a clerical ministry was driven from office, and replaced by laymen who proved, however, less effective administrators than their predecessors. Meanwhile Aquitaine was gradually lost; the defeat of Pembroke off La Rochelle deprived England of the command of the sea, and Sir Owen ap Thomas, a grand-nephew of Llewelyn ab Gruffyd, planned, with French help, an abortive invasion of Wales. In 1371 the Black Prince came back to England with broken health, and in 1373 John of Lancaster marched to little purpose through France, from Calais to Bordeaux. In 1372 Edward made his final effort to lead an army, but contrary winds prevented his even landing his troops in France. In 1375 he was glad to make a truce, which lasted until his death. By it the only important possessions remaining in English hands were Calais, Bordeaux, Bayonne and Brest.

Edward was now sinking into his dotage. After the death of Queen Philippa he fell entirely under the influence of a greedy mistress named Alice Perrers, while the Black Prince and John of Gaunt became the leaders of sharply divided parties in the court and council of the king. With the help of Alice Perrers John of Gaunt obtained the chief influence with his father, but his administration was neither honourable nor successful. His chief enemies were the higher ecclesiastics, headed by William of Wykeham, bishop of Winchester, who had been excluded from power in 1371. John further irritated the clergy by making an alliance with John Wycliffe. The opposition to John was led by the Black Prince and Edmund Mortimer, earl of March, the husband of Edward's grand-daughter, Philippa of Clarence. At last popular indignation against the courtiers came to a head in the famous Good Parliament of 1376. Alice Perrers was removed from court, and Duke John's subordinate instruments were impeached. But in the midst of the parliament the death of the Black Prince robbed the commons of their strongest support. John of Gaunt regained power, and in 1377 a new parliament, carefully packed by the courtiers, reversed the acts of the Good Parliament. Not long after, Edward III. died, on June 21, 1377.

Edward III. was not a great man like Edward I. He was, however, an admirable tactician, a consummate knight, and he possessed extraordinary vigour and energy of temperament. His court, described at length in Froissart's famous chronicle, was the most brilliant in Europe, and he was himself well fitted to be the head of the magnificent chivalry that obtained fame in the French wars. Though his main ambition was military glory, he was not a bad ruler of England. He was liberal, kindly, good-tempered and easy of access, and his yielding to his subjects' wishes in order to obtain supplies for carrying on the French war contributed to the consolidation of the Constitution. His weak points were his wanton breaches of good faith, his extravagance, his frivolity and his self-indulgence. Like that of Edward I. his ambition transcended his resources, and before he died even his subjects were aware of his failure.

Edward had 12 children, seven sons and five daughters. Five of his sons played some part in the history of their time, these being Edward the Black Prince, Lionel of Antwerp, duke of Clarence, John of Gaunt, duke of Lancaster, Edmund of Langley, afterwards duke of York, and Thomas of Woodstock, afterwards duke of Gloucester. John and Edmund are also important as the founders of the rival houses of Lancaster and York. Each of the last four was named from the place of his birth, and for the same reason the Black Prince is sometimes called Edward of Woodstock. The king's two other sons both died in infancy. Of his daughters, three died unmarried; the others were Isabella, who married into the family of Coucy, and Mary, who married into that of Montfort.

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EDWARD IV. (1442–1483), king of England, son of Richard, duke of York, by Cicely Neville, was born at Rouen on April 28, 1442. As a boy he was styled earl of March, and spent most of his time at Ludlow. After the Yorkist failure at Ludlow field in October 1459, Edward fled with the earls of Salisbury and Warwick, his uncle and cousin, to Calais. Thence in the following July he accompanied them in their invasion of England, to be welcomed in London, and to share in the victory over the Lancastrians at Northampton. After the acceptance of Richard of York as heir to the crown, Edward returned to the Welsh marches, where early in the new year he heard of his father's defeat and death at Wakefield. Hastily gathering an army he defeated the earls of Pembroke and Wiltshire at Mortimer's Cross on Feb. 2, 1461, and then marched on London. He was acclaimed by the citizens in an assembly at Clerkenwell, declared king by a Yorkist council, and took possession of the regality on March 4. Soon after the new king and the earl of Warwick went north, and on March 28, won a decisive victory at Towton.

Edward owed his throne to his kinsmen the Nevilles, and he was content for the time to be guided by them. For himself he was young and fond of pleasure. He fought in the north during 1462 and 1463, but he was absent from the final victory at Hexham on May 4, 1464, being engaged in contracting a secret marriage with Elizabeth, daughter of Richard Woodville, Lord Rivers, and widow of Sir John Grey of Groby (*d.* 1461). The marriage was disclosed at Michaelmas, much to the vexation of Warwick, who had projected a match with a French princess. Edward heaped favours on his new relatives; his father-in-law was made treasurer, and great marriages were found for his wife's sisters and brothers. In foreign affairs also Edward thwarted Warwick's plans by favouring an alliance with Burgundy rather than France. There was, however, no open breach till 1469, when Warwick, taking advantage of the unpopularity of the Woodvilles, and supported by the king's next brother George, duke of Clarence, appeared in arms. Edward was surprised and made prisoner at Middleham, and Rivers was beheaded. For six months Edward had to submit to Warwick's tutelage; then on the occasion of a rising in Lincolnshire he gathered an army of his own. Sir Robert Welles, the leader of this rebellion, made a confession implicating Warwick, who fled with Clarence to France. The king thought himself secure, but when Warwick and Clarence made terms with the Lancastrian exiles, Edward in his turn had to seek refuge in Holland (September 1470). His brother-in-law, Charles of Burgundy, at first refused him any assistance, but at last furnished him with money, and on March 14, 1471 Edward and his brother Richard landed with a small force at Ravenspur near Hull. Marching south he was welcomed at London on April 11, defeated Warwick at Barnet three days later, and the Lancastrians at Tewkesbury on May 4. From thenceforth Edward's possession of the crown was secure. His position was strengthened by the birth of a son (Nov. 2, 1470, during his exile), and by the wealth which he acquired through the confiscation of the estates of his opponents. Clarence had made his peace with Edward, but was at enmity with his other brother Richard of Gloucester, who now married Warwick's second daughter and claimed a share in the Neville inheritance. Their rivalry and Clarence's continued intrigues furnished Edward with his chief domestic difficulty; the trouble was ended by the judicial murder of Clarence in 1478.

The only serious enterprise of these latter years was the short French war of 1475, from which Edward was bought out by the treaty of Pecquigny. The peace shows a certain recognition of England's need to concentrate her energies on her own development. The annual subsidy from Louis XI. provided Edward with money for home government, and enabled him to avoid possible trouble through the necessity for too frequent parliaments and heavy taxation. So Edward's personal rule became in its character autocratic: but it was in the art of courting popularity and concealing despotism that he most shows himself as a type of tyranny. He could be ruthless, but was not habitually cruel. His strongest weapons were the fine presence, the affable manners (even with citizens), and the love of pleasure and entertainments which secured his personal popularity. In his last years he was given to self-indulgence and scandalous excesses, which did not, however, alienate the London citizens, with whose wives he was too familiar. Most of the power at court was in the hands of the Woodvilles, in spite of their unpopularity; the more arduous work of administration in the north was left to Richard of Gloucester. If as a prince of the Renaissance Edward was the first to rule tyrannically in England, he also deserves credit as a patron of the new culture and friend of Caxton, he further resembles his Italian contemporaries in the commercial purposes to which he applied his wealth in partnership with London merchants.

Edward died at Westminster on April 9, 1483, and was buried at Windsor. By Elizabeth Woodville, who died on June 8, 1492, he had two sons, Edward V. and Richard of York, who were murdered in the Tower; and five daughters, of whom the eldest, Elizabeth, married Henry VII. Of his numerous mistresses the most notorious was Jane Shore. Before his marriage he had been contracted to Lady Eleanor Butler, and this was alleged by Richard III. to have made his children by Elizabeth Woodville illegitimate.

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EDWARD V. (1470–1483), king of England, was the elder son of Edward IV. by his wife Elizabeth Woodville, and was born, during his father's temporary exile, in the sanctuary of Westminster Abbey on Nov. 2, 1470. In June 1471 he was created prince of Wales. When Edward IV. died in April 1483 a struggle for power took place between the young king's paternal uncle, Richard, duke of Gloucester, who had been appointed as his guardian by Edward IV., and his maternal uncle, Richard Woodville, Earl Rivers. Gloucester obtained possession of the king's person, and, having arrested Rivers and some of his supporters, assumed the crown himself after a very slight and feigned reluctance, on the ground that the marriage of Edward and Elizabeth Woodville was invalid, and consequently its issue was illegitimate. At this time Edward and his brother Richard, duke of York, were living in the Tower of London. Shortly afterwards a movement was organized to free them from captivity, and then it became known that they were already dead; but, though it was the general conviction that they had been murdered, it was 20 years before the manner of this deed was discovered. According to the narrative of Sir Thomas More, Sir Robert Brackenbury, the constable of the Tower, refused to obey Richard's command to put the young princes to death: but he complied with a warrant ordering him to give up his keys for one night to Sir James

Tyrell, who had arranged for the assassination. Two men, Miles Forest and John Dighton, then smothered the youths under pillows while they were asleep. The murder was committed most probably in Aug. or Sept. 1483. Horace Walpole has attempted to cast doubts upon the murder of the princes, and Sir C. R. Markham has argued that the deed was committed by order of Henry VII. Both these views, however, have been traversed by James Gairdner, and there seems little doubt that Sir Thomas More's story is substantially correct.

See RICHARD III.; and in addition, Horace Walpole, *Historic Doubts on the Life and Reign of Richard III.* (1768); Sir Thomas More, *History of Richard III.*, ed. J. R. Lumby (Cambridge, 1883); J. Gairdner and C. R. Markham in the *English Historical Review*, vol. vi. (1891); J. Gairdner, *Richard III.* (Cambridge, 1898); Sir C. R. Markham, *Richard III.* (1907).

EDWARD VI. (1537–1553), king of England and Ireland, born at Greenwich on Oct. 12, 1537, was the only child of Henry VIII. by his third wife, Jane Seymour, who died of puerperal fever 12 days later. The story that the mother's life was deliberately sacrificed by the performance of Caesarean section is unfounded, although Jane's death was little noticed amid the rejoicings which greeted the advent of a male heir to the throne. But in spite of Holbein's vivacious portrait of Edward at the age of two (now at Hanover), he was a frail child, and a short life was anticipated for him from his early years. This did not prevent a strenuous education. Sir John Cheke, Sir Anthony Cooke and Roger Ascham all helped to teach him Latin, Greek and French; and by the age of 13 he had read Aristotle's *Ethics* in the original and was himself translating Cicero's *De philosophia* into Greek.

Edward was duke of Cornwall from his birth, but he was never prince of Wales, and he was only nine when he succeeded his father as king of England and Ireland and supreme head of the church (Jan. 28, 1546/7). His nonage threw power into the hands of Somerset and then of Northumberland, and enabled Gardiner and Bonner to maintain that the royal supremacy over the church was, or should be, in abeyance. Projects for his marriage were hardly even the occasion, but only the excuse, for Somerset's war on Scotland and Northumberland's subsequent alliance with France. All factions sought to control his person; he was an indispensable adjunct to the wielder of authority. The Protector's brother tried to bribe him with pocket-money; Northumberland was more subtle and established a complete dominion over his mind, and then put him forward at the age of 14 as entitled to all the power of Henry VIII. But he was only Northumberland's mask; of his individual influence on the course of history during his reign there is hardly a trace. A posthumous effort was made to give him the credit of a humane desire to save Joan Bocher from the flames; but he recorded with apparently cold-blooded indifference the execution of both his uncles, and he made no attempt to mitigate the persecution of his sister Mary.

Edward showed signs of all the Tudor obstinacy, and he was a fanatic into the bargain, as no other Tudor was except Mary. The combination would probably have involved England in disasters far greater than any that ensued upon his premature death; and it was much better that the Anglican settlement of religion should have been left to the compromising temper of Elizabeth. His health began to fail in 1552, and in May 1553 it was known that he was dying. But his will and the various drafts of it only betray the agitated and illogical efforts of Northumberland to contrive some means whereby he might continue to control the Government and prevent the administration of justice. Mary and Elizabeth were to be excluded from the throne, as not sufficiently pliant instruments; Mary Stuart was ignored as being under Scottish, Catholic and French influence; the duchess of Suffolk, Lady Jane's mother, was excluded because she was married, and the duke her husband might claim the crown matrimonial. In fact, all females were excluded, except Jane, on the ground that no woman could reign; even she was excluded in the first draft, and the crown was left to "the Lady Jane's heirs male." But this draft was manipulated so as to read "the Lady Jane and her heirs male." That Edward himself was responsible for these delirious provisions is improbable, but his last recorded words were vehement injunctions to Cranmer to sign the will. He died at Greenwich on July 6, 1553, and was buried in Henry VII.'s chapel by Cranmer with Protestant rites on Aug. 8, while Mary had Mass said for his soul in the Tower.

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EDWARD VII. (Albert Edward) (1841–1910), king of Great Britain and Ireland, and of the British Dominions beyond the Seas, emperor of India, the eldest son and second child of Queen Victoria and of Albert, prince of Saxe-Coburg and Gotha, was born at Buckingham Palace on Nov. 9, 1841. He was created prince of Wales and earl of Chester on Dec. 4 following, and was baptized on Jan. 25, 1842. In his childhood he was educated by the dowager Lady Lyttleton; and in his boyhood successively by the Rev. Henry Mildred Birch, Mr. F. W. Gibbes, the Rev. C. F. Tarver and Mr. Herbert W. Fisher. He afterwards resided at Edinburgh, studying chemistry in its industrial applications under Professor (afterwards Lord) Playfair at the university; at Christ Church, Oxford; and at Trinity College, Cambridge. In Nov. 1858 he was made a knight of the Garter and a colonel in the army. In 1859 he travelled in Italy and Spain, and in 1860 paid a visit as "Lord Renfrew" to the United States and Canada.

Upon the completion of his Cambridge course in June 1861 he joined the camp at the Curragh. The prince consort died on Dec. 13, and in 1862 the prince of Wales went for a tour in the Holy Land (Feb.–June) under the guidance of Arthur Penrhyn Stanley, afterwards dean of Westminster. Early in 1863 he was sworn of the privy council, and took his seat in the House of Lords as duke of Cornwall. The estate of Sandringham, in Norfolk, was purchased for him out of the savings of his minority, and his town residence was fixed at Marlborough House.

His impending marriage to the princess Alexandra, daughter of Christian IX., king of Denmark (b. Dec. 1, 1844) had already been announced, and took place on March 10, at Windsor, the beauty and grace of the princess captivating the heart of the nation. Parliament granted the prince an income of £40,000 a year, exclusive of the revenues of the duchy of Cornwall, and he relinquished his right of succession to the duchy of Saxe-Coburg-Gotha. Prince Albert Victor, afterwards duke of Clarence, was the first off-spring of the marriage, being born on Jan. 8, 1864. The births followed of Prince George Frederick Ernest Albert, afterwards Duke of York (*see* GEORGE V.), on June 3, 1865; Princess Louise Victoria Alexandra Dagmar, by marriage duchess of Fife, princess royal, on Feb. 20, 1867. Princess Victoria Alexandra Olga Mary, on July 6, 1868; and Princess Maud Charlotte Mary Victoria, afterwards queen of Norway, on Nov. 26, 1869.

From the time of their marriage the prince and princess were prominently before the country. Queen Victoria remained in retirement, but they filled her place at important public functions. The prince's readiness to promote every worthy cause was most marked; no one was a more constant attendant at meetings for objects of public utility of a non-political nature, and his speeches were always characterized by excellent sense. The most important external event of these years was a tour to Egypt, undertaken in 1869 in company with the duke of Sutherland, Sir Samuel Baker and others, an account of which was published by Mrs. William Grey. The prince also visited Ireland more than once, and opened the International Exhibition of 1871.

On Nov. 23, 1871, it was announced that the prince would be prevented by a feverish attack from paying a visit which had been arranged to the Maharajah Dhuleep Singh. It soon appeared

that the malady was typhoid, contracted as was supposed on a visit to Scarborough. The case became so serious that on Nov. 29 the queen and Princess Alice hurried to Sandringham. On Dec. 1 there was a slight rally, but on the 5th so serious a relapse occurred that for some days the prince's life was despaired of. Under the skilful treatment of Sir William Jenner, Sir William Gull, Sir James Paget, and Sir Oscar Clayton, however, the crisis was surmounted by Dec. 16, and by Christmas day the danger was regarded as virtually over. On Feb. 27, 1872, a thanksgiving was held at St. Paul's, amid imposing demonstrations of public joy.

In Jan. 1874 the prince of Wales attended the marriage at St. Petersburg of his brother, the duke of Edinburgh, with the grand-duchess Marie of Russia. In the same year he paid a historic visit to Birmingham, where Joseph Chamberlain, not yet a member of parliament, received him officially as mayor. In March 1875 it was announced that he would make a visit to India, carrying out an idea originally conceived by the first Indian viceroy, Earl Canning. He was supposed to travel as heir-apparent, not as representative of the queen: but the characters could not be kept apart, and in fact the prince's visit was a political event of great importance. Leaving England on Oct. 11, he was received at Bombay by the viceroy, Lord Northbrook. Here he met a very large number of Indian feudatory princes, whose acquaintance he subsequently improved by visiting at their courts during the 17 weeks which he spent in the country. During these four months the prince travelled nearly 8,000 m. by land and 2,500 m. by sea, became acquainted with more rajahs than had all the viceroys who had reigned over India, and saw more of the country than any living Englishman. The visit led up to the queen's assumption of the title of empress of India in the following year.

The prince's life after this date was full of conspicuous public appearances. In 1885 he visited Ireland at a time of much political excitement, and was received enthusiastically in many quarters and without symptoms of ill-will in any. In 1886 he filled the presidency of the Indian and Colonial Exhibition, opened the Mersey Tunnel, and laid the first stone of the Tower Bridge. In 1887 a large share of the arrangements for the queen's Jubilee devolved upon him. On July 27, 1889, his eldest daughter, Princess Louise, was married to the duke of Fife. In the autumn he paid a semi-incognito visit to Paris, where he was always highly popular, viewed the Exhibition and ascended the Eiffel Tower. In 1890 he opened the Forth Bridge. On Jan. 14, 1892, however, a heavy blow fell upon him and his house by the death of his eldest son Prince Albert Victor, duke of Clarence, after a brief illness. The young prince, who with his brother George had made the tour of the world (1879–81) in H.M.S. "Bacchante" and after a short career at Oxford and Cambridge was just settling down to play his part in public life, had recently become engaged to Princess Victoria Mary of Teck (b. May 26, 1867), and the popularity of the heir to the crown had been increased by the expression of his satisfaction at his son's bride being an English princess. On July 6, 1893, the broken thread was reunited by her marriage to Prince George, duke of York.

The year 1894 was a busy one for the prince of Wales, who became a member of the royal commission on the housing of the poor, opened the Tower Bridge, attended the Welsh Eisteddfod and was duly initiated, and paid two visits to Russia—one for the marriage of the grand-duchess Xenia, the other for the funeral of the emperor, his brother-in-law. In 1896 he became first chancellor of the university of Wales, and his first act after his installation at Aberystwyth was to confer an honorary degree upon the princess. He had already been for some years a trustee of the British Museum, and a member of the Standing Committee which he attended with great regularity. On July 22, 1896, his daughter Princess Maud was married to prince Charles of Denmark, who in 1905 was elected and accepted the crown of the new kingdom of Norway. The arrangements for the queen's [illegible]

the fleet presided at the naval review at Spithead. In July 1898 the prince had the misfortune to fracture his knee-cap while on a visit to Baron Ferdinand de Rothschild, but completely recovered from the effects of the accident. In Dec. 1899, while passing through Brussels on his way to St. Petersburg, he was fired at by a lad named Sipido, crazed by reading anarchist literature. Fortunately no injury was done.

It was the especial distinction of Albert Edward, while prince of Wales, to have been a substantial support of the throne before he was called upon to fill it. This cannot be said of any of his predecessors except Edward the Black Prince. He was exemplary in the discharge of his public duties, and in his scrupulous detachment from party politics. He was a keen patron of the theatre, and his thoroughly British taste for sport was as pronounced as his inclination for most of the contemporary amusements of society. His connection with the turf increased his personal popularity and it did him no disservice with the people to have twice won the Derby with his horses Persimmon (1896) and Diamond Jubilee (1900)—his third victory, in 1909, with Minoru, being the first occasion on which the race had been won by a reigning sovereign; and his interest in yacht-racing was conspicuously shown at all the important fixtures, his yacht "Britannia" being one of the best of her day. His activity in the life of the nation may be illustrated by his establishment (1897) of the Prince of Wales's (afterwards King Edward's) Hospital Fund, his devotion to the cause of Masonry (he was first elected grand master of the Freemasons of England in 1874), and his position as a bencher of the Middle Temple, where he also became (1887) treasurer.

On the death of Queen Victoria on Jan. 22, 1901, the question what title the new king would assume was speedily set at rest by the decision, made on his own initiative, that he would be called Edward the Seventh. This popular announcement was made at a privy council at St. James's Palace, at which the king declared his intention to follow in his predecessor's footsteps, and govern as a constitutional sovereign. On Feb. 14 the king and queen opened parliament in state. Shortly afterwards it was announced that the visit of the duke and duchess of York to Australia, in order to inaugurate the new Commonwealth, which had been sanctioned by Queen Victoria, would be proceeded with; and on March 16 they set out on board the "Ophir" with a brilliant suite. The tour lasted till Nov. 1, the duke and duchess having visited Australia, New Zealand, the Cape and Canada; and on their return the king, on Nov. 9, created the duke prince of Wales and earl of Chester. Meanwhile parliament had settled the new civil list at £470,000 a year, and the royal title had been enlarged to include the colonial empire by an act enabling the king to style himself "Edward VII., by the grace of God, of the United Kingdom of Great Britain and Ireland, and of all the British Dominions beyond the Seas, King, Defender of the Faith, Emperor of India." At the end of May 1902 the long-drawn-out war in South Africa came at last to an end, and the coronation was fixed for June 26. But on the 24th, amid general consternation, the king was announced to be suffering from perityphlitis, necessitating the immediate performance of an operation; and the coronation, for which unprecedented preparations had been made, had to be postponed. The operation—performed by Sir Frederick Treves—was, however so successful, and the king's progress towards recovery so rapid and uninterrupted, that within a fortnight he was pronounced out of danger, and soon afterwards it was decided to hold the coronation service on Aug. 9. Though shorn of much of the interest which would have been added to it in June by the presence of foreign royalties and the preparation for a great procession through London, the solemnity duly took place on that date in Westminster Abbey amid great rejoicings. The king spent several weeks (partly in a yachting trip round the coast and up to Stornoway) in recruiting his health, and on Oct. 25 he went in procession through the main streets of south London, when he was most en[illegible]

At home the king opened parliament in person in Feb. 1903 and on March 31 he sailed from Portsmouth to pay a visit to the king of Portugal at Lisbon leaving Lisbon for Gibraltar on April 7. On the 11th he held a review of the garrison troops and next day left for Malta, and the tour was continued to Naples (April 23). On April 27 he was received at Rome by the king of Italy—the first time an English king as such had been there; and two days later he paid a visit to Leo XIII. at the Vatican. On May day he was received in Paris by President Loubet. Later in the year return visits were paid to England by President Loubet (July) and the king and queen of Italy (Nov.). On May 11 His Majesty paid his first formal visit to Edinburgh, and held courts at Holyrood. In July the king and queen went to Ireland, and though the Dublin corporation refused to vote a loyal address the reception was generally cordial. In September the king took his annual "cure" at Marienbad, and paid a visit to Vienna, where he was received by the Austrian emperor. In 1904, again the king and queen went to Ireland; in June the king was cordially received by the German emperor at the yacht-races at Kiel, and he included a visit to Hamburg, where the welcome was hearty. In November the king and queen of Portugal were entertained at Windsor and at the Guildhall.

The success of King Edward as a promoter of international friendliness, and the advantage of so efficient a type of kingship, attracted universal attention, and treaties of arbitration were concluded by Great Britain with France, Spain, Italy, Germany and Portugal, in 1903 and 1904. In his first two years the king had already earned the title of Edward the Peacemaker, and established his position as a source of new strength to the state. This reputation was confirmed in the years which followed, during which the royal hand was to be seen in the progress of foreign affairs in a manner somewhat new to politicians accustomed to the less conspicuous activities of Queen Victoria. The *entente* with France was promoted by his influence, notably by his reception of and by two French presidents of the Republic in Paris and London. It was noticed that the permanent under-secretary for foreign affairs, Sir Charles Hardinge, generally accompanied the king, as one of his suite, on his visits abroad: and the conclusion of the Anglo-Russian agreement (1907)—which was attributed with some reason to royal policy—was criticized in Radical quarters. It was pointed out that neither the foreign secretary (Sir E. Grey) nor any other secretary of state accompanied the king on his foreign visits. These objections were, however, scouted by the king's ministers and undeniably public opinion approved of the sovereign's personal activity in a sphere peculiarly his own. The strengthening of British influence in Europe, which was the marked result of the Anglo-French and Anglo-Russian *ententes*, and of the closer ties between England and countries like Portugal and Spain (whose young king Alfonso married Princess Ena of Battenberg, King Edward's niece), had, indeed, temporarily the effect of rousing German suspicion, the view taken being that the object of British foreign policy was to isolate Germany; and during 1907 and 1908 the political situation was coloured by the discussions in the press with regard to Anglo-Germany rivalry. But in Feb. 1909, in spite of the perfunctory attitude of the German press, the king and queen paid a state visit to the Kaiser in Berlin, where cordiality was displayed on all sides; the event was prepared for in both countries, as a means of dispelling the clouds which had gathered over the relations between England and Germany, and the success of the visit proved once more how powerful King Edward's personality could be as an agency for peace and international amity.

During the year 1909, however, the political situation at home was developing into an acute constitutional crisis, which seemed likely to involve the Crown in serious difficulties. Lloyd George's budget convulsed the House of Commons and the country, and was eventually rejected by the House of Lords; and the Liberal government now put in the forefront of its programme the abolition of the Peers' "veto." This grave political disturbance coincided with a failure in the king's physical powers, which had, for three years, caused anxiety to his intimate friends. Although certainly not prejudiced against a Liberal ministry, the king was seriously disturbed by the progress of events which culminated in the return of Asquith to office after the elections of Jan. 1910, and in his statement that, if necessary, guarantees would be sought from the Crown for the purpose of enforcing the will of the representative Chamber. A remarkable sign of the king's discomfort was his insertion in the official "King's Speech" at the opening of parliament, of the words "in the opinion of my advisers," in connection with the passage dealing with the House of Lords. The king while he was taking change and rest at Biarritz in the early spring of 1910 had a bronchial attack of unusual severity which caused some anxiety, although the public heard nothing of it. In the country at large there was indeed considerable confidence that the king's tact and experience would help to solve the grave difficulties that were confronting his government and the country, but this was not to be. Within two days the public heard with consternation that he was ill, and then he was dead. On May 5 it was announced that he had bronchitis; and he died at 11.45 p.m. on the 6th of heart failure. On May 17, 18 and 19 there was an impressive lying-in-state in Westminster Hall, attended by unprecedented crowds; and on May 20 the burial took place at Windsor, after a funeral procession through London, the coffin being followed by the new king, George V., and by eight foreign sovereigns—the German emperor, the kings of Greece, Spain, Portugal, Denmark, Norway, Belgium and Bulgaria—besides the archduke Franz Ferdinand of Austria (heir to the throne of Austria Hungary), the prince consort of Holland and many other royalties and a number of special ambassadors, including Roosevelt as representative of the United States. Mourning was as sincere as it was universal; for not only England and the British Empire, but the world, had lost a king who had rendered and was rendering great service to his people, and whose personal charm was recognized by men and women of every class.

Queen Victoria's long reign had solidly established the constitutional monarchy; it remained for her son to rehabilitate the popular aspect of English kingship. While prince of Wales he had had widespread knowledge of public affairs, but little training in state-craft. When he became king his genuine capacity for affairs was a matter of general surprise. Ably advised by such men as Lord Knollys and Lord Esher, he devoted himself to the work of removing the Throne from its former isolation and bringing it into touch with all sections of the community for the promotion of social happiness and welfare. His own love of pageantry and his interest in the stately ordering of court functions responded moreover to a marked inclination on the part of the public and of "society."

When all is said of the value of King Edward's intimate knowledge of foreign courts and of his personal popularity in foreign capitals, it is essential to insist that he undertook no formal negotiations, nor did he act except on the advice of his ministers. While helping to win for his country a high place in the councils of the world, he kept careful watch upon the course of events at home. The smoothness of his co-operation with his Ministers was not the least among his successes as a ruler and both Sir Henry Campbell-Bannerman (for whom the king came to have a strong personal regard) and Asquith were wise enough to recognize and to use his knowledge of international politics and his personal influence with Continental statesmen. It was significant that even Radicals and Socialists began to advocate extensions of the prerogative, and to insist on the active part which the Crown should play in public life. The king won the genuine affection and confidence of the people; and in Queen Alexandra he had an ideal consort to whom all hearts went out.

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[illegible] ... of My L[illegible] ... 90[illegible] ... 90[illegible]. For foreign [illegible] Edward VII., see J. Bardoux, *Victoria; Edward VII, George V.* [illegible] 1911) and Hermann, Freiherrn von Eckardstein *Persönliche Erinnerungen an König Edward* (Dresden, 1927).

(H. C.; E.)

EDWARD, prince of Wales, known as "The Black Prince" (1330–1376), the eldest son of Edward III. and Philippa of Hainault, was born at Woodstock on June 15, 1330. Contemporaries called him Edward of Woodstock, and his surname of the Black Prince cannot be traced back earlier than the 16th century. It is supposed to have been derived from his wearing black armour. In 1333 he was made earl of Chester, and in 1337 duke of Cornwall, being the first duke ever created in England. Nominal warden of England during his father's absences abroad in 1338 and 1342, he was created prince of Wales in 1343, and in 1345 he first accompanied his father on a foreign expedition.

His real career begins, however, with Edward III.'s Norman campaign of 1346. He commanded the right wing of the English forces at Crécy, and, though hard pressed for a time by the French, took his full share in gaining the victory. Next year he was at the siege of Calais, and returned to England in October 1347 with his father. He was one of the original knights of the Garter, and participated in his father's chivalrous adventures at Calais in 1349 and in the battle of Winchelsea in 1350. In September 1355 he was sent to Gascony at the head of an English army, having been appointed his father's lieutenant there in July. He was warmly welcomed by the Gascons, and at once led a foray through Armagnac and Languedoc. By November he had got as far as Narbonne, whence he returned to Bordeaux, where he kept his Christmas court. In August 1356 he started from Bergerac on another marauding expedition, this time in a northerly direction. He penetrated as far as the Loire, but was there compelled to retire before the superior forces of King John of France. On Sept. 19, the two armies met in the battle of Poitiers, fought about 6 m. S.E. of the city. Edward's victory was due both to the excellence of his tactical disposition of his forces and to the superior fighting capacity of his army. The flank march of the Captal de Buch, which decided the fate of the day, was of Edward's own devising, and the captivity of King John attested the completeness of his triumph. He treated his prisoner with magnanimity, and took him to Bordeaux, whence they sailed to England in May 1357. On the 24th of that month he led his prisoner in triumph through the streets of London. In 1359 he took part in his father's invasion of northern France, and had a large share in the negotiations at Brétigny and Calais.

In October 1361 Edward married his cousin Joan, countess of Kent (1328–85), the daughter and heiress of Edmund of Woodstock, earl of Kent, the younger son of Edward I. by his second wife Margaret of France. The lady was the widow of Sir Thomas Holand, by whom she had had three children. Froissart says that the marriage was a love match, and that the king had no knowledge of it. But Edward III. approved of his son's choice, and in July 1362 handed over to him all his dominions in southern France, with the title of prince of Aquitaine. In February 1363 Edward and Joan took ship for Gascony, which became his ordinary place of residence for the next eight years. He maintained a brilliant court at Bordeaux and Angoulême, and did his best to win the support of the Gascons. He was not, however, successful in winning over the greater nobles, who, with John, count of Armagnac, at their head, were dissatisfied with the separation from France, and looked with suspicion upon Edward's attempts to reform the administration as being likely to result in the curtailment of their feudal rights. Edward was better able to conciliate the towns, whose franchises he favoured and whose trade he fostered, hoping that they would prove a counterpoise to the aristocracy. He kept the chief posts of the administration mainly in English hands, and never really identified himself with the local life and traditions of his principality. He succeeded in clearing Aquitaine of the free companies, and kept good peace for nearly six years.

In 1367 Peter the Cruel, the deposed king of Castile, visited Edward at Bordeaux, and persuaded him to restore him to his throne by force. In February 1367 Edward led an army into Spain over the pass of Roncesvalles. After a difficult and dangerous march Edward reached the Ebro, and on April 3 defeated Bertrand du Guesclin at Nájera, the last of his great victories. He then proceeded to Burgos, and restored Peter to the throne of Castile. He remained in Castile for four months, living principally at Valladolid. His army wasted away during the hot Spanish summer, and Edward himself contracted the beginnings of a mortal disease. In August 1367 Edward led the remnant of his troops back through the pass of Roncesvalles, and returned to Bordeaux early in September. He was now forced to seek from the estates of Aquitaine extraordinary sources of supply. A hearth tax for five years was willingly granted to him, and generally paid. The greater barons, however, found in this impost a pretext for revolt. The count of Armagnac appealed against the hearth tax to the parlement of Paris. Cited before this body in January 1369, Edward declared that he would answer at Paris with sixty thousand men behind him.

War broke out again, and Edward III. resumed the title of king of France. Thereupon Charles V. declared that all the English possessions in France were forfeited, and before the end of 1369 all Aquitaine was in full revolt. Though too ill to ride on horseback, the Black Prince insisted upon commanding his troops, and on Sept. 19, 1370 won his last barren success, by capturing the revolted city of Limoges and putting the population to the sword. Early in 1371 he returned to England, leaving the impossible task of holding Gascony to his brother John of Gaunt. In October he resigned his principality on the ground that he could not afford to retain any longer so expensive a charge. His health now rapidly declined, but he did what he could to support the constitutional opposition of the great ecclesiastics to the administration of John of Gaunt and the anti-clerical courtiers. His last public act was to inspire the attack on Lancaster's influence made by the Good Parliament in the spring of 1376. He died at Westminster on July 8. He was buried in the east end of Canterbury cathedral on Sept. 29, where his magnificent tomb, erected in accordance with the instructions in his will, may still be seen. By Joan, "the fair maid of Kent," who died on Aug. 7, 1385, the Black Prince left an only son, afterwards King Richard II.

For authorities *see* Edward III. To these may be added W. Hunt's article in the *Dict. Nat. Biog.*; A. Collins, *Life of Edward, Prince of Wales* (1740); G. P. R. James, *Life of Edward the Black Prince* (1839); J. Moisant, *Le Prince Noir en Aquitaine* (1894); R. P. Dunn-Pattison, *The Black Prince* (1910); W. H. St. J. Hope, *The Achievements of Ed. in the Cathedral Church of Canterbury* (1895); Sir I. Gollancz, *Ich Dene* (1921).

(T. F. T.)

EDWARD, PRINCE OF WALES (1894–), eldest son of King George V. and Queen Mary, at that time duke and duchess of York, was born on June 23, 1894, at White Lodge, Richmond park, and baptised 23 days later by the archbishop of Canterbury as Edward Albert Christian George Andrew Patrick David. In 1902 H. P. Hansell was appointed his tutor, and remained with him from that time until Aug. 1914. During 1902–7 the prince was prepared for the navy, and in the spring of 1907 he entered Osborne, where he remained for two years before going on to the Royal Naval college, Dartmouth. While a cadet at Dartmouth he performed his first public duty on March 29, 1911, by presenting to the mayor and corporation of that town the silver oar which they had held formerly as a symbol of the rights associated with the bailiwick of the water of Dartmouth.

At the close of his Dartmouth training in June 1911, he was invested as a Knight of the Garter, and on July 13, 1911, after his father's accession he was created prince of Wales and earl of Chester. About the same time the duchy of Cornwall was bestowed upon him. He was shortly afterwards invested as prince of Wales in Carnarvon Castle, and on this occasion for the first time an English prince addressed the Welsh people in their own tongue. Shortly after this event the prince became a midshipman, and was appointed to H.M.S. "Hindustan," in which ship he served for three months. During the spring of 1912 the prince spent five months in Paris as the guest of the marquis de Breteuil, and was coached by Maurice Escoffier in the language and history of the country. In Oct. 1912 the prince entered

Magdalen college Oxford with Major the Hon. William Cadogan (10th Hussars) as equerry. At Oxford the prince took part in the corporate life of the college and the usual athletic amusements of the undergraduates. He resided in college rooms, dined in hall or at one of the university clubs, and mixed freely with his fellow undergraduates. Some of his vacations he spent in European travel, visiting Germany twice, in 1912 and 1913, and Denmark and Norway in 1914. The prince's university career was ended by the outbreak of the World War in Aug. 1914. On Aug. 7 he was gazetted to the Grenadier Guards, and on the 11th he joined the 1st Battalion at Warley barracks, Essex.

In Nov. 1914 the prince, who had been appointed aide-de-camp to Sir John French, arrived in France and took up his new duties at British G.H.Q. at St. Omer. During the next 18 months he served with the Expeditionary Force in Flanders and in France in various parts of the line, being first attached to the 2nd Division under Sir H. S. Horne, to the I. Corps under Sir Charles Monro, and later to the Guards Division under the Earl of Cavan. In March 1916 he was appointed to the staff of the general officer commanding the Mediterranean Expeditionary Force, and proceeded at once to Egypt. He took the opportunity of seeing the troops in various parts of the line, and also went as far south as Khartum. On his return journey he paid a visit to the Italian headquarters at Udine, and by the middle of June had returned to the British armies in France. He was then attached to the XIV. Corps (Lord Cavan) in Flanders and France and subsequently proceeded with this corps, in Oct. 1917, to the Italian front, where he remained till Aug. 1918. In May 1918 the Prince paid a semi-official visit to Rome; he then returned to France and was attached to the Canadian Corps, with whom he was serving at the time of the Armistice. He was attached to the Australian Corps in Belgium till the beginning of 1919 after which he visited the Army of Occupation on the Rhine, spending a few days with the New Zealand Division, and paying a short visit to General Pershing at the American headquarters at Coblenz.

On his return journey to England at the end of Feb. 1919 the prince almost immediately took up a number of public duties which had of necessity been deferred during the war, and on May 29 was admitted to the freedom of the City of London. On Aug. 5, 1919, he left Portsmouth in H.M.S. "Renown" for Newfoundland and Canada, first setting foot on Canadian soil on Aug. 15 at St. John, New Brunswick. His tour extended through the entire dominion from east to west, and five days after reaching Victoria on Sept. 23 the return journey began. The Canadian tour ended at Ottawa, and on Nov. 10 the prince left for Washington to pay a short official visit to the President of the United States. New York was subsequently visited, and after a long series of official engagements, the prince sailed for Halifax, where he bade good-bye to Canada, reaching Portsmouth on Dec. 1.

After a short stay in England, the prince sailed again in H.M.S. "Renown" on March 16, 1920 for New Zealand and Australia. The first port of call was Bridgetown, Barbados, and then, passing through the Panama Canal, the prince paid short visits to San Diego (Cal.), Honolulu and Fiji, Auckland being reached on April 24 after a voyage of 14,000 miles. A month was spent in New Zealand, all parts of the North and South islands were visited, and on May 26 the prince landed at Melbourne. During his stay in Australia he visited all the states of the Commonwealth, and eventually sailed from Sydney on Aug. 19. On the return journey he stopped at Fiji, Samoa, Honolulu and Acapulco, and, after passing once again through the Panama Canal, the prince spent three weeks in the West Indies. The last port of call was Bermuda, and H.M.S. "Renown" eventually reached Portsmouth on Oct. 11, 1920.

After a brief holiday, spent for the greater part in the hunting field, he resumed his public duties after Christmas 1920. During the first six months of 1921 he was occupied chiefly in London, but found time to visit, among other places, Oxford, Cambridge, Glasgow and the Clyde, his property in Devon, Cornwall and the Scilly Isles; Cardiff, Newport and Bristol. On Oct. 26 he sailed in the "Renown" on a state visit to India, visiting Gibraltar, Malta (where he opened the first Maltese parliament) and Aden, landing at Bombay on Nov. 11. After several weeks in India, he sailed from Calcutta for Rangoon (Jan. 2, 1922) and proceeded to Mandalay, returning thence to Madras (Jan. 13). There, as previously at Bombay, some rioting occurred in the native quarters on the day of his arrival; but on the whole he was splendidly received, even though attempts were made by the Swarajists, with occasional success, to persuade the population to remain indoors. At Delhi on Feb. 14 he received an address from the Indian legislature. After visiting the north-west frontier he eventually embarked at Karachi on March 7, sailing thence to Japan, touching on the way at Colombo, Port Swettenham, Singapore and Hong Kong, and reaching Tokio on April 12. He remained in Japan till May 9, and on the voyage home visited Manila, Borneo, Penang and Cairo, reaching Plymouth on June 20.

In April 1923 he paid a visit to Brussels in order to dedicate the monument erected by the British government to show British gratitude for kindness shown to British prisoners of war after the Armistice, and then revisited the battlefields in Flanders and northern France. On Sept. 5 he sailed for Canada on a private visit to his ranch in Alberta, returning to England on Oct. 20. On April 23, 1924, as president of the British Empire Exhibition at Wembley, he received King George at the opening ceremony. He was also present at the close on Nov. 1. In the meanwhile he had again spent a short time on his ranch in Canada; on his way there he visited the United States in a private capacity, in order to witness the international polo matches, and took the opportunity of calling on President Coolidge, with whom he had luncheon at the White House. During 1923–24 he visited various industrial areas, including west Yorkshire, Birmingham, Newcastle-on-Tyne, Nottingham, Dundee, North Wales and the Potteries district.

On March 28, 1925, he sailed in the "Repulse" for West and South Africa. Landing at Bathurst on April 4 he visited in turn Gambia, Sierra Leone, the Gold Coast and Nigeria. Leaving Lagos on April 22, he reached Cape Town on April 30, and after a short stay proceeded through the Cape Province and into the native territories of the Transkei. His journey was continued through the Orange Free State, and at Maseru he was greeted by 50,000 Basuto horsemen. During his stay in Natal he opened a new dock at Durban and was there welcomed by 23,000 Indians. He went through Zululand, Swaziland and thence to Pretoria and Johannesburg, where he opened the University of the Witwatersrand; then via Mafeking and the Bechuanaland Protectorate he travelled through Southern and Northern Rhodesia.

On the return journey to Cape Town he visited Kimberley. After spending three months in South Africa he sailed on July 29 for South America, having accepted an invitation conveyed to him in 1924 by the president of the Argentine republic, to visit that country. Touching only at St. Helena for two days, he arrived at Montevideo Aug. 14. After three days spent in Uruguay, he reached Buenos Aires on Aug. 17, stayed for a time in the capital, and made one or two tours in the country, including a journey of 1,500 miles to the cattle-raising districts in the provinces of Entre Rios and Corrientes. He crossed the Andes into Chile, visiting Santiago and Valparaiso, and after some delay, owing to avalanches of snow in the mountains, returned to Buenos Aires. Sailing from Mar del Plata for England on Sept. 27, he touched at the Cape Verde islands, Oct. 8, and reached Portsmouth on Oct. 16. In 1926 the prince underwent a slight operation for ear trouble which temporarily interfered with his public duties. Nevertheless, in that year he presided over the British Association at Oxford, and paid an official visit to Paris when, with the President, he opened the Canadian Students' hostel.

In 1927 he visited many of the great industrial centres in Great Britain. In August and September he paid a visit to Canada with Stanley Baldwin, the prime minister, to take part in the centenary celebrations of the Canadian confederation, and took the opportunity of visiting his Canadian ranch. He made many friends in Canada, and renewed earlier friendships. His passion for sport and for outdoor life found an outlet at home in the hunting-field. But he was punctilious in fulfilling his official duties and in his

[illegible] showed a wit and spontaneity which won him many friends.

Some indication of the pressure of his public life is given by the fact that in May 1928 an aeroplane was placed at his disposal for travelling to his official duties.

In September 1925, he left London for East Africa, accompanied by his brother the Duke of Gloucester, landing at Mombasa on Sept. 29. While he was on a shooting expedition, the news of the King's illness caused him to abandon his tour and he reached London on Dec. 11, having travelled 6,000 miles in 14 days. In 1926 the prince made a tour of some of the most depressed coalfields. He arranged his visits himself, inspected paysheets and conditions and his comments drew much public sympathy to the miners' sufferings.

EDWARD, LAKE, in Central Africa, the southern of the two western reservoirs of the Nile, formerly known as Albert Edward Nyanza. It lies in the Albertine rift-valley between 0° 8′ and 0° 40′ S. and 29° 28′ and 29° 52′ E., at an elevation of 3,004 ft. above the sea. It is roughly oval in shape and has no deep indentations. On its N.E. side it is connected by a winding channel, 25 m. long and from a quarter of a mile to a mile wide, flowing between high banks, with a smaller sheet of water, Lake Dweru which extends north of the equator. Lake Edward has a length of 44 m. and a breadth of 32 m. (*maximum measurement*) Dweru is about 20 m. long and 10 across at its widest part. The area of the two lakes is approximately 820 sq.m.

A swampy plain, traversed by the Ruchuru and other rivers, extends south of the Nyanza and was once covered by its waters. The plain contains several salt-pans, and at the S.E. corner are numerous geysers. Along the eastern shore the low land extends to Kamarangu, about midway between the south and north ends of the lake, a considerable stretch of ground intervening between the wall of the rift-valley and the water, two terraces being clearly defined. The euphorbia trees and other vegetation on the lower terrace are small and apparently recent. At some distance from the lake runs a belt of forest. North of Kamarangu the wall of the valley approaches the water in a series of bluffs some 300 to 350 ft. high. At the N.E end the hills again recede and the plain widens to include Dweru. On the west side of the lake the wall of the rift-valley runs close to the lake shore and at the N.W. corner the mountains close in on the water. North of the lake a high alluvial plain stretches to the southern slopes of the Ruwenzori mountains. From Ruwenzori a subsidiary range, the Kipura mountains, runs due south to the lake shore, where it ends in a low rounded hill. In general, the plain rises above the lake in a series of bold bluffs, a wide margin of swamp separating them from the water. The Semliki, the only outlet of the lake, issues from its N.W. end. Round the north-eastern shore of the lake are numerous crater lakes, many salt, the most remarkable being that of Katwe. This lake lies west of the Dweru channel and is separated from Lake Edward by a ridge of land, not more than 160 ft. in breadth. The sides of this ridge run down steeply to the water on either side. The waters of the Katwe lake have a beautiful rose colour which becomes crimson in the shadows. The salt is highly prized and is exported to great distances.

The main feeder of Lake Edward, and western head-stream of the Nile, the Ruchuru, rises on the north side of the volcanoes north of Lake Kivu (*see* MUMBIRO). On reaching the level plain 15 m. from the lake its waters become brackish, and the vegetation on its banks is scanty. The reedy marshes near its mouth form a retreat for a primitive race of fishermen. Lake Dweru, the shores of which are generally high, is fed by the streams from the eastern slopes of the Ruwenzori range. One of these, the Mpango, is a larger river than the Ruchuru. The outlet of the lake, the Semliki, and the part played by the lake in the Nile system are described under ALBERT, LAKE (A. NYANZA). (*See also* AFRICA: *Geography and Geology* and NILE.)

A feature of Lake Edward is the [illegible] which overhangs the water during the [illegible] from view the mountains. In the rains, when the sky is clear, the magnificent panorama of hills encircling the lake on the west and north-west [illegible]. The lake water is clear, of a light green colour and distinctly brackish. Fish abound, as do waterfowl, crocodiles and, in the southern swamps, hippopotami. In the rainy season the lake is subject to violent storms.

The entire area of Lake Edward was found, by the work of the Anglo-German Boundary Commission of 1902–04, to lie within the limits of the sphere of influence of the Congo Free State as defined in the agreement of May 12, 1894, between that state and Great Britain. Dweru was discovered in 1875 by H. M. Stanley, then travelling westward from Uganda, and by him was named Beatrice gulf in the belief that it was part of Lake Albert. In 1888–89 Stanley, approaching the Nile region from the west, traced the Semliki to its source in Lake Edward, which lake he discovered, naming it after Albert Edward, prince of Wales, afterwards Edward VII. Stanley also discovered the connecting channel between the larger lake and Dweru. The accurate mapping of the lake was mainly the work of British officials and travellers, such as Scott Elliott, Sir F. D. Lugard, Ewart Grogan, J. E. Moore and Sir H. Johnston; while Emin Pasha and Franz Stuhlmann, deputy-governor (1891) of German East Africa, explored its southern shores.

EDWARDES, SIR HERBERT BENJAMIN (1819–1868), English soldier-statesman in India, was born at Frodesley, Shropshire, on Nov. 12, 1819. He was nominated in 1840 to a cadetship in the East India Company, and was posted (1841) ensign in the 1st Bengal Fusiliers. In November 1845 Edwardes was appointed aide-de-camp to Sir Hugh (afterwards Viscount) Gough, then commander-in-chief in India. He served with Gough through the Sikh war, then in a civil appointment in the trans-Sutlej territory, and on Dec. 18 he was severely wounded at the battle of Mudki. He soon recovered, however, and fought by the side of his chief at the decisive battle of Sobraon (February 10, 1846). He was soon afterwards appointed third assistant to the commissioners of the trans-Sutlej territory; and in January 1847 he was named first assistant to Sir Henry Lawrence, the resident at Lahore. He took part with Lawrence in the suppression of a religious disturbance at Lahore in the spring of 1846, and assisted him in reducing, by a rapid movement to Jammu, the conspirator Imam-ud-din. In 1847 he conducted an expedition to Bannu, a district on the Waziri frontier, where the revenue had fallen into arrear. Edwardes conquered the wild tribes of the valley without firing a shot, and concluded fiscal arrangements which obviated all difficulty of collection for the future. In the spring of 1848, after the murder of van Agnew and Anderson at Multan, by order of the diwan Mulraj, Edwardes occupied [illegible]ah on the left bank of the Indus, was joined by Colonel van Cortlandt, and, although he could not attack Multan, held the enemy at bay and gave a check at the critical moment to their projects. He won a victory over a superior Sikh force at Kineri (June 18). Edwardes took part in the siege and capture (1849) of Multan under General Whish. His account of the campaign, *A Year on the Punjab Frontier in 1848–1849*, was written during a short period of leave in England, after which he returned to the Punjab. Lawrence, whose trusted lieutenant he was, sent him (1853) to the Peshawar frontier as commissioner. He was stationed there when the Indian Mutiny broke out. It was a position of enormous difficulty. Edwardes rose to the occasion. He effected a reconciliation with Afghanistan, and secured the neutrality of the amir and the frontier tribes during the war. So effective was his procedure for the safety of the border that he was able to raise a large force in the Punjab and send it to co-operate in the siege of Delhi. After three years rest in England (1859–62), during which he was created K.C.B. with the rank of brevet-colonel, he returned to India as commissioner of Umballa and agent for the Cis-Sutlej states. In February 1865 failing health compelled him to retire. In May 1866 he was created K.C.S.I. and early in 1868 was promoted major-general in the East Indian Army. He died in London on Dec. 23, 1868. The life of Sir Henry Lawrence on which he was engaged was finished by Herman Merivale after his death.

See *Memorials of the Life and Letters of Sir Herbert Benjamin Edwardes, by his wife* (2 vols., 1886); T. R. E. Holmes, *Four Soldiers* (1889); J. Ruskin, *Bibl. pastorum*, iv. "A Knight's Faith" (1883), passages from the life of Edwardes.

EDWARDS, ALFRED GEORGE (1848–), first archbishop of Wales, was born at Llanymawddwy on Nov. 2, 1848, and was educated at Jesus college, Oxford. He was ordained in 1874, and in 1875 became warden and headmaster of the college at Llandovery, holding this position until 1885, when he was appointed vicar of Carmarthen. In 1889 he was chosen bishop of St. Asaph. In 1920, after the disestablishment of the Welsh Church, of which disestablishment he had been an active opponent, he was elected first archbishop of Wales.

Among his publications may be mentioned *The Church in Wales* (1888); *Common Sense Patriotism* (1894); and *Landmarks in Welsh Church History* (1912).

EDWARDS, AMELIA (1831–1892), English author and Egyptologist, born in London. She wrote novels, the most successful of which were *Debenham's Vow* (1870) and *Lord Brackenbury* (1880). After her visit to Egypt in 1873 she devoted herself to Egyptology. Convinced that only proper scientific research could preserve the antiquities of Egypt, she helped to form the Egypt Exploration Fund. She published in 1877 *A Thousand Miles Up the Nile*, and in 1891 *Pharaohs, Fellahs and Explorers*, the substance of lectures delivered in America the previous year. She died in Weston-super-Mare, leaving her collections to University college, London, and endowing a chair of Egyptology.

See K. S. Macquoid, *Julia Kavanagh, Amelia Blandford Edwards* (1897).

EDWARDS, BRYAN (1743 to 1800), English politician and historian, was born at Westbury, Wilts., on May 21, 1743. About 1759 he went to join his uncle in Jamaica, and subsequently succeeded to his estates there. He sat in the colonial assembly of Jamaica and in 1796, by which time he had finally returned to England, became M.P. for Grampound, retaining his seat till his death at Southampton on July 15 or 16, 1800. A supporter of the slave trade, he was a powerful opponent of Wilberforce. His great book is a *History of the British Colonies in the West Indies* (5 vols.).

See the biographical sketch prefixed to the 1801 edition of his *History of the West Indies*.

EDWARDS, ENOCH (1852–1912), British Labour politician, was born at Talk-o'-the-Hill, Staffs., on April 10, 1852. He was the son of a pitman, and worked as a boy in a coal-mine. In 1870 he was appointed treasurer and in 1877 secretary of the North Staffordshire Miners' Association. In 1884 he became member of the school board and town council of Burslem, and later alderman and mayor. In 1880 he became president of the Midland Miners' Association; he was later president of the Miners' Federation of Great Britain and member of the Staffordshire county council. In 1906 he was elected Labour M.P. for Hanley. He died at Southport on June 28, 1912.

EDWARDS, GEORGE (1693–1773), English naturalist, was born at Stratford, Essex, on April 3, 1693. After travelling extensively over Europe, he was appointed librarian to the Royal College of Physicians in London in 1733. His *History of Birds* (4 vols., 1743–51) with three supplementary volumes, *Gleanings of Natural History* (1758–64), contain engravings and new descriptions of more than 600 subjects in natural history, and an index of Linnaean names supplied by Linnaeus himself with whom Edwards frequently corresponded. He also wrote *Essays of Natural History* (1770) and *Elements of Fossilogy* (1776). Edwards died at Plaistow, Essex, on July 23, 1773.

EDWARDS, HENRY THOMAS (1837–1884), Welsh divine, was born on Sept. 6, 1837, at Llan ym Mawddwy, Merioneth, where his father was vicar. He became vicar of Aberdare in 1866 and of Carnarvon in 1869, where he began his lifelong controversy with the Welsh Nonconformists. In 1870 he fought in vain for the principle of all-round denominationalism in the national education system, and in the same year addressed a letter to Gladstone on "The Church of the Cymry," pointing out that the success of Nonconformity in Wales was largely due to 'the withering effect of an alien episcopate." One result of this was the appointment of the Welshman Joshua Hughes (1807–89) to the vacant see of St. Asaph. Edwards became dean of Bangor in 1876 and promoted a clerical education society for supplying the diocese with educated Welsh-speaking clergy. He died by his own hand on May 24, 1884 at Ruabon.

See V. Morgan, *Welsh Religious Leaders in the Victorian Era*.

EDWARDS, JONATHAN (1703–1758), American theologian, was born on Oct. 5, 1703, at East Windsor, Conn. His father, Timothy Edwards, was pastor of the Congregational church in East Windsor, and his mother, a daughter of Rev. Solomon Stoddard of Northampton, Mass., pastor of the church where Jonathan Edwards, himself, was afterwards installed.

He showed a certain abnormal mental precocity and wrote a tract on "The Nature of the Soul" when he was ten years old. At 12 he composed a treatise on "The Habits of Spiders." He entered Yale college at 13, read Locke's *Essay Concerning Human Understanding*, which impressed him deeply, at 14, and at 17 graduated from Yale at the head of his class of ten as valedictorian.

He remained in New Haven for two more years, studying theology, and became acting pastor of a small Presbyterian church in New York for eight months. He was then tutor in Yale for two years. In 1727 came the call to Northampton, where he won his fame and also suffered the keenest humiliation of his life.

Predestination.—He was ordained as assistant minister to his grandfather, Solomon Stoddard. In that same year he married Sarah Pierrepont, who was only 17, a daughter of one of the founders of Yale, a girl who combined piety with a bright, cheerful disposition. She proved a devoted wife, an efficient housekeeper, and the faithful mother of his 12 children. Two years later Solomon Stoddard died, leaving young Edwards in sole charge of one of the largest, wealthiest and most cultured congregations in Massachusetts.

He was brought up by godly parents so that pious habits were to him as second nature. Yet somewhere in that period of study, he entered into a new and deeper sense of his personal relation to God. He would scarcely have called it conversion because he had been faced toward the light from the first. Like John Wesley, however, his heart was "strangely warmed" until the doctrine of divine sovereignty, against which he had formerly rebelled, became a belief "exceedingly pleasant, bright, and sweet." It may have been so. We are told that the doctrine of "unconditional election," whereby certain souls are, by no act or choice of their own, predestined to eternal bliss, and other souls in similar fashion to eternal damnation, is very comforting to those who are convinced that they are numbered with the elect. When Edwards entered upon his duties as pastor of the Northampton church, he showed at once that he loved books and abstract ideas more than he loved people. He spent 13 hours a day in his study and hardly ever called upon his parishioners except in cases of extreme emergency. He inherited apparently his father's lack of amiability in that he displayed a certain intellectual satisfaction in picturing "sinners in the hands of an angry God." He seemed to find more joy in battering the strongholds of Arminianism and in rearing the stout defences of his own Calvinistic theology than in preaching good tidings to the poor, or binding up the broken-hearted.

His first public attack on Arminianism in an address at Boston in 1731 was published under the title, *God Glorified in Man's Dependence*. He maintained that, while it was fitting that God should in the beginning create man holy, it was of his good pleasure and "mere arbitrary grace" that any man was now made holy. He claimed that God might withhold this saving grace, if he chose, without any disparagement to his moral perfection. He insisted steadily that men had no rights which a just and holy God was under moral obligations to respect.

The fiery sermons of Edwards had an immediate effect upon his hearers, their own sense of the imminence of hell making them susceptible. In his *Life of Edwards*, A. V. G. Allen indicates the conditions in Northampton at that time. "A town predisposed to religion by all its antecedents; a moment in its history when no great external interest preoccupied the minds of the people; an isolated town where the want of healthy amusements had a tendency to breed as a substitute the mere

Fettered Will and Choice [illegible] x month [illegible] own church, and there was a similar situation elsewhere. Hundreds of people were turned from lives of evil-doing, but in the light of certain larger considerations which must enter into any just appraisal of "the Great Awakening," this can not be regarded as an unmixed blessing. The particular type of conversion, singled out and exalted until it would almost seem that other modes of entrance into Christian life were deemed spurious, was abnormal. It was far less wholesome than the type of conversion advocated by Horace Bushnell in his *Christian Nurture.* And to compare Edwards with another great religious leader, born in the same year, "the necessity of conversion was asserted by John Wesley, the Founder of Methodism, with a vigour and success which Calvinism could not rival, embarrassed as it was by the prior distinction between the elect and the non-elect which Wesley totally rejected." Edwards's attempt to set that notion upon its feet again led to a confusion in New England theology which was a millstone upon its neck for many years. There was an inconsistency in his teaching which the discriminating people of his own day must have detected. He declaimed against "the freedom of the will," but went about calling upon men everywhere to use their wills in forsaking their sins and choosing the Christian way of life. He insisted that no man had power to repent (unless he was fortunate enough to have been foreordained to repentance), yet he urged men with all his might to repent and turn to the Saviour. He preached the terrors of hell, even to young children. "As innocent as young children seem to be to us, yet if they are out of Christ they are in God's sight young vipers, and infinitely more hateful than vipers." Yet he and his wife cheerfully brought into the world 12 children of their own and lived with them apparently on terms of friendly, affectionate intercourse.

Ideas on Freewill.—He was sadly lacking in the humanities. The human values were obscured by his passion for metaphysics in his ambitious theological treatises. He had little feeling for poetry or for the beauties of the natural world. It was a perpendicular piety which he preached—it did not find adequate expression in those horizontal relations and interests which make up the social order.

His tedious discussion of *The Freedom of the Will*, commonly regarded as his *magnum opus*, impresses the modern reader as a solemn bit of special pleading, rather than a disinterested effort to reach the truth. His methods of biblical interpretation as judged by the more competent scholarship of our own day are hardly worthy of consideration or of respect. He felt that he must demolish the freedom of the will in order to cut the ground from under the feet of his Arminian opponents. If the will were free, in the sense that a man can choose his way, thus giving evidence of a self-determining power, the people in their arrogance would despise the Calvinistic doctrines which spring from the idea of God's absolute sovereignty and his unconditional election of certain souls to eternal life. One of the foremost theologians in the American pulpit, George A. Gordon, has said of him, "No single treatise of Edwards can to-day commend itself to a free and informed mind. In his Freedom of the Will, the Religious Affections, the Nature of Virtue, God's final End in Creation, the Christian Church can not follow him as a whole and those who insist upon all or none, do their best to make it none."

Dismissed from Northampton.—In 1748 there came the open rupture between this pastor and his congregation. Two causes for this dissension have ordinarily been assigned. First, a badly managed case of discipline, where the pastor instituted proceedings against a number of his young people for circulating "impure books." However just or unjust his estimate of certain popular volumes may have been, he managed to alienate the [illegible] the young people of the town. [illegible] toward "the Halfway Covenant" [illegible] not consciously "converted" [illegible] the Kingdom of God to be excluded from ha[illegible]ng the[illegible]r ch[illegible]ldren adm[illegible]ed to the privileges of one sacrament, while they were so far outside a state of grace as to be debarred themselves from participating in the other sacrament at the Lord's table. Edwards stood for an even more rigorous exclusion and this meant a clash with established usage. The reasons for the opposition of the church lay deeper than these two causes. There was a ground-swell of dissent from the violent expressions employed against those who had not experienced what he regarded as thorough-going "conversion" and a profound distrust as to the wholesome influence of much of the teaching which had accompanied the Great Awakening. The effects of his overdone emphasis upon the fear of hell as a source of motive and of his low estimate of the human factor in redemption were coming home to roost. The members of the church voted by a majority of more than 200 to 23 to dismiss the pastor and the church council approved the action of the church. Then the town voted that Edwards should not be permitted to preach again in that community.

Wanderings.—He bore his disappointment as a Christian. His farewell sermon was dignified, temperate and without recrimination. But he had been turned out of his pastorate at the age of 47 with a large family to support and no immediate employment at hand by which he could earn a livelihood. He was offered a church in Virginia and there was an opening in Scotland. He declined both of these opportunities and in 1750 became pastor of the church in Stockbridge and missionary to the Housatonic Indians. He probably discharged his duties with fidelity, according to the habit of his life, but his missionary efforts were not greatly blessed. He loved books and theological disputation more than he loved Indians. He used his spare time at Stockbridge to write his *Original Sin, The Nature of True Virtue* and his *Essay Concerning the End for which God Created the World.* He also devoted four months to writing his great work on *The Freedom of the Will.*

In 1757 his son-in-law, Aaron Burr, president of the College of New Jersey, died quite suddenly. This institution had shown much more sympathy with the revival which Edwards sponsored than either Harvard or Yale. It was natural, therefore, that two days after the death of President Burr, Jonathan Edwards was elected president of what is now Princeton university. It was an attractive call, yet he hesitated about accepting it. His reluctance sprang from his desire to complete a *History of the Work of Redemption* which would set forth his theological conceptions as a finished whole. It may be just as well for his own fame and for the Christian religion that this projected work was never brought out.

He entered immediately upon his duties, preaching for several Sundays in the College hall and giving out "questions in Divinity" to the senior class. His period of service, however, was very brief. Smallpox was epidemic in New Jersey. The physician counselled inoculation and Edwards, with the approval of the college authorities, was inoculated on Feb. 13. For a time the symptoms indicated a speedy recovery, but there came a change for the worse and on March 22, 1758, he died in his fifty-fifth year. His wife died the following September.

Notable tributes to the vigour and range of his intellect in dealing with metaphysical problems have been paid by scholarly men on both sides of the Atlantic. He was an earnest, sincere, devoted Christian, according to the methods and standards of the period in which he wrought. His work is to be judged in the light of religious conceptions prevalent at that time; the potent influence which it exerted occasions wonder rather than grateful appreciation. His most sympathetic biographer concludes his accurate and kindly review with these significant words—"The great wrong which Edwards did, which haunts us as an evil dream throughout his writings, was to assert God at the expense of humanity."

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EDWARDS, LEWIS (1809–1887). Welsh Nonconformist divine, was born in the parish of Llanbadarn Fawr, Cardiganshire, on Oct 27, 1809. In 1832 he settled as minister at Laugharne, Carmarthenshire, and the following year went to Edinburgh, where a special resolution of the senate allowed him to graduate at the end of his third session. He was now better able to further his plans for providing a trained ministry for the Calvinistic Methodists; he made his home at Bala, and there, in 1837, with David Charles, his brother-in-law, opened the school that ultimately became the denominational college for North Wales; a new college was built at Bala in 1867, for which he raised £10,000.

Edwards may fairly be called one of the makers of modern Wales. Through his hands there passed generation after generation of preachers, who carried his influence to every corner of the principality. It was due to him that the North and South Wales Calvinistic Methodist Associations united to form an annual General Assembly; he was its moderator in 1866 and again in 1876. He died on July 19, 1887.

See *Bywyd a Llythyrau y Parch.* (*i.e.*, Life and Letters of the Rev.) *Lewis Edwards, D.D.*, by his son T. C. Edwards.

EDWARDS, RICHARD (*c.* 1523–1566), English musician and playwright, was born in Somersetshire, became a scholar of Corpus Christi college, Oxford, in 1540, and took his M.A. degree in 1547. He was appointed in 1561 a gentleman of the chapel royal and master of the children, and entered Lincoln's Inn in 1564, where at Christmas in that year he produced a play which was acted by his choir boys. On Sept. 3, 1566 his play, *Palamon and Arcite*, was performed before Queen Elizabeth in the Hall of Christ Church, Oxford. Another play, *Damon and Pithias*, tragic in subject but with scenes of vulgar farce, entered at Stationers' Hall in 1567–68, appeared in 1571 and was reprinted in 1582; it may be found in Dodsley's *Old Plays*, vol. i., and *Ancient British Drama*, vol. i. It is written in rhymed lines of rude construction, varying in length and neglecting the *caesura*. A number of the author's shorter pieces are preserved in the *Paradise of Dainty Devices* (1575); one of these finishes a stanza to *Romeo and Juliet*. The *Historie of Damocles and Dionise* is assigned to him in the 1578 edition of the *Paradise*. Sir John Hawkins credited him with the part song "In going to my lonely bed"; the words are certainly his, and probably the music. The fine poem, "The Soul's Knell," is supposed to have been written by him when dying.

See *Grove's Dict. of Music*; the *Shakespeare Soc. Papers*, vol. ii. art. vi.; Ward, *English Dram. Literature*, vol. i.; Leicester Bradner, *Life and Poems of Richard Edwards* (1928).

EDWARDS, THOMAS CHARLES (1837–1900), Welsh Nonconformist divine and educationist, was born at Bala, Merioneth, on Sept. 22, 1837, the son of Lewis Edwards (*q.v.*). After graduating in London, he matriculated at St. Alban Hall, Oxford, in 1862, obtained a scholarship at Lincoln College in 1864, and took a first class in the school of Literae Humaniores in 1866. In 1867 he became minister at Windsor Street, Liverpool, but left it to become first principal of the University College of Wales at Aberystwyth in 1872. When the college was destroyed by fire in 1885 he collected £25,000 to rebuild it; the remainder of the necessary £40,000 being given by the government (£10,000) and by the people of Aberystwyth (£5,000). In 1891 he became principal of the theological college at Bala. He died on March 22, 1900. His chief works were a *Commentary on 1 Corinthians* (1885), the *Epistle to the Hebrews* (Expositor's Bible, 1888), and *The God-Man* (Davies Lecture, 1895).

EDWARDSVILLE, a city of Illinois, U.S.A., 18m. N.E. of Saint Louis, near Cahokia creek; the county seat of Madison county. It is on Federal highway 66, and is served by the Nickel Plate and the Wabash and electric railways. The population was 5,336 in 1920 and was estimated locally at over 8,000 in 1928. Coal is mined near by (3,530,848 tons in 1926), and it has numerous manufacturing industries, including canneries, marble works, flour and planing mills, brick and tile plants and factories making woodwork, brass, radiators, shirts and powdered milk. Adjoining Edwardsville is the plant of the N. O. Nelson Manufacturing company (plumbers' supplies, etc.), and the co-operative village Leclaire (unincorporated; pop. about 2,000) founded in 1890 by Nelson O. Nelson for his employés, with various welfare features in the village and some degree of profit-sharing in the business. Edwardsville was settled in 1812, laid out in 1815 and named after Ninian Edwards, governor of the Territory at the time. It was incorporated in 1819. The prehistoric Monk's mound is near.

EDWARDSVILLE, an anthracite-mining borough of Luzerne county, Pa., U.S.A., on the Susquehanna river, opposite Wilkes-Barre. The post-office is Kingston Station, Wilkes-Barre. In 1920 the population was 9,027 (32% foreign-born white). The borough was incorporated in 1884.

EDWIN, Aedwini or Edwine (585–633), king of Northumbria, was the son of Ella of Deira. On the seizure of Deira by Aethelfrith of Bernicia (probably 605), Edwin was expelled and is said to have taken refuge with Cadfan, king of Gwynedd. After the battle of Chester, in which Aethelfrith defeated the Welsh, Edwin fled to Raedwald, the powerful king of East Anglia, who after some wavering espoused his cause and defeated and slew Aethelfrith at the river Idle in 617. Edwin thereupon succeeded to the Northumbrian throne, driving out the sons of Aethelfrith. There is little evidence of external activity on the part of Edwin before 625. It is probable that the conquest of the Celtic kingdom of Elmet, a district in the neighbourhood of the modern Leeds, ruled over by a king named Cerdic (Ceredig) is to be referred to this period, and this may have led to the later quarrel with Cadwallon, king of Gwynedd. Edwin seems also to have annexed Lindsey to his kingdom by 625.

In this year he entered upon negotiations with Eadbald of Kent for a marriage with his sister Aethelberg. It was made a condition that Christianity should be tolerated in Northumbria, and accordingly Paulinus was consecrated bishop by Justus in 625, and was sent to Northumbria with Aethelberg. According to Bede, Edwin was favourably disposed towards Christianity owing to a vision he had seen at the court of Raedwald, and in 626 he allowed Eanfled, his daughter by Aethelberg, to be baptized. On the day of the birth of his daughter, the king's life had been attempted by Eomer, an emissary of Cwichelm, king of Wessex. Preserved by the devotion of his thegn Lilla, Edwin vowed to become a Christian if victorious over his treacherous enemy. He was successful in the ensuing campaign, and abstained from the worship of the gods of his race. A letter of Pope Boniface helped to decide him, and after consulting his friends and counsellors, among whom the priest Coifi later took a prominent part in destroying the temple at Goodmanham, he was baptized with his people and nobles at York, at Easter 627. In this town he granted Paulinus a see, built a wooden church and began one of stone. Besides York, Yeavering and Maelmin in Bernicia, and Catterick in Deira, were the chief scenes of the work of Paulinus. It was the influence of Edwin which led to the conversion of Eorpwald of East Anglia.

Bede notices the peaceful state of Britain at this time, and relates that Edwin was preceded on his progresses by a kind of standard like that borne before the Roman emperors. In 633 Cadwallon of North Wales and Penda of Mercia rose against Edwin and slew him at Hatfield near Doncaster. His kinsman Osric succeeded in Deira, and Eanfrith the son of Aethelfrith in Bernicia. Bede tells us that Edwin had subdued the islands of Anglesey and Man, and the *Annales Cambriae* record that he besieged Cadwallon (perhaps in 632) in the island of Glannauc (Puffin island). He was definitely recognized as overlord by all the other Anglo-Saxon kings of his day except Eadbald of Kent.

See Bede, *Hist. Eccl.* (ed. Plummer, Oxford, 1896), ii. 5, 9, 11, 12, 13, 15, 16, 18, 20; Nennius (ed. San Marte, 1844), § 63; *Vita S. Oswaldi*, ix. Simeon of Durham (ed. Arnold, 1882–85, vol. i. R.S.). (F. G. M. B.)

EDWIN, JOHN (1749–1790), English actor, was born in London on Aug. 10, 1749, the son of a watchmaker. His first London appearance was at the Haymarket in 1776 as Flaw in Samuel

... *The* [illegible], and when George Colman took over the ... he became its leading actor. In 1779 he was at Covent ... rden and played there or at the Haymarket until his death on ... 31, 1790. Ascribed to him are *The Last Legacy of John* ... 1780, *Edwin's Jests* and *Edwin's Pills to Purge Melan-* ...

His son John Edwin (1768–1805) made a first appearance ... the stage at the Haymarket as Hengo in Beaumont and ... tcher's *Bonduca* in 1778, and from that time acted frequently ... th his father. In 1791 he married Elizabeth Richards, an actress ... eady well known in juvenile parts, and played at the Haymarket ... d elsewhere thereafter with her. He died in Dublin on Feb. 22, ... 05. His widow joined the Drury Lane company (then playing, ... account of the fire of 1809, at the Lyceum), and took all the ... ding characters in the comedies of the day. She died on Aug. ... 1854.

EDWY (Eadwig), "The Fair" (*c.* 940–959), king of the ... glish, eldest son of Edmund and Aelfgifu, succeeded his uncle ... dred in 955, when he was about 15 years old. He was crowned ... Kingston by Archbishop Odo. At the coronation feast he re- ... d with Aethelgifu (perhaps his foster-mother) and her daugh- ... Aelfgifu, whom the king intended to marry. The nobles ... ented the king's withdrawal, and he was induced by Dunstan ... d Cynesige, bishop of Lichfield, to return to the feast. Edwy ... ented this interference, and in 957 at the instigation of Aethel- ... Dunstan was driven into exile. By the year 956 Aelfgifu had ... ome the king's wife, but in 958 Archbishop Odo of Canterbury ... ured their separation on the ground of their being too closely ... d. The chief men of Mercia and Northumbria were disgusted ... Edwy's partiality for Wessex; and in the year 957 his brother, ... Aetheling Edgar, was chosen as king by the Mercians and ... rthumbrians. It is probable that no actual conflict took place. ... In 959, on Edwy's death, Edgar acceded peaceably to the ... joined kingdoms of Wessex, Mercia and Northumbria.

... *The Anglo-Saxon Chronicle* (ed. Plummer, 1892–99), *sub. ann.*; ... *morials of St. Dunstan* (ed. Stubbs, Rolls Series); William of ... lmesbury, *Gesta regum* (ed. Stubbs, Rolls Series); Birch, *Cartu-* ... *um Saxonicum*, vol. ii, Nos. 932–1046.

EECKHOUT, GERBRAND VAN DEN (1621–1674), ... tch painter, born at Amsterdam on Aug. 19, 1621, was a pupil ... Rembrandt. He assumed Rembrandt's manner with such suc- ... s that his pictures were confounded with those of his master ... evidence of the fidelity of Eeckhout's imitation we may cite his ... esentation in the Temple," at Berlin, which is executed after ... mbrandt's print of 1630, and his "Tobit with the Angel," at ... nswick, which is composed on the same background as Rem- ... ndt's "Philosopher in Thought." His earliest pieces are prob- ... y those in which he more faithfully reproduced Rembrandt's ... uliarities. Exclusively his is a tinge of green in shadows mar- ... g the harmony of the work, a certain gaudiness of jarring tints, ... form surface, and a touch more quick than subtle. Besides the ... tures already mentioned we should class amongst early produc- ... as on this account the "Woman taken in Adultery," at Amster- ... n, the "Resurrection of the Daughter of Jairus" at Berlin; the ... resentation in the Temple" at Dresden; the "Lady at the Dress- ... table" (1643) at Vienna; "Anna presenting her Son to the ... gh Priest," in the Louvre, Paris; the "Epiphany," at Turin; ... d the "Circumcision," at Cassel. Eeckhout matriculated early ... the Gild of Amsterdam. As he grew older he succeeded best in ... traits, a very fair example of which is that of the historian ... ppers (1669), in the Städel collection and that of the four chiefs ... the Wine Gild at the National Gallery, London. Eeckhout ... [illegible] the "small ... [illegible] attention to ... [illegible] "Soldiers' ... [illegible] Bute. A ... [illegible] now in the ... [illegible] Goats" ... [illegible] ace of the ... [illegible] it's works ... [illegible] aman and ... [illegible] He also executed some engravings. Eeckhout died at Amsterdam on Sept 22, 1674.

EEDEN, FREDERIK WILLEM VAN (1860–), Dutch poet, novelist and playwright, was born at Haarlem on April 3, 1860, and educated for the medical profession. He was one of the leaders of the literary revival of 1880, and founded in 1885 with D. Kloos and A. Verwey the *Nieuwe Gids*, the organ of the younger men of letters. In that paper appeared his most famous novel *De kleine Johannes* (1887; Eng. trans. *Little Johannes*, 1895), to which two later parts were added in 1905 and 1906. It was followed by *Ellen* (1891), a cycle of elegies full of the melancholy mysticism which informs van Eeden's verse, *Johannes Viator* (1892), a story which was hailed as "a new Bible" when it first appeared; *Lioba* (1897), a drama; *Van de koele Meren des Doods* (1900; Eng. trans. *The Deeps of Deliverance*, 1902); *De Nachtbruid* (1909); *Sirius en Siderius* (1912, etc.) and other works. In 1898 van Eeden founded at Bussum the agricultural and industrial community known as the Walden Colony from the title of Thoreau's book.

See P. Verschave, "Un converti hollandais—Le poète Frédéric van Eeden," *Correspondant*, Tome 296, pp. 311–338 (Paris, 1924); *Het roode lamp je, signifische gepeinzen* (Amsterdam, 1921).

EEL, the name given generally to fishes of the order Apodes, and particularly to the common or fresh-water eel of Europe (*Anguilla anguilla*). The Apodes are soft-rayed fishes with a duct to the air-bladder, elongate, with small gill-openings, without pelvic fins, and generally with long dorsal and anal fins confluent with the reduced caudal. The congers and the morays (*Muraena*) are well known members of this large group of marine fishes, all of which have compressed transparent pelagic larvae, known as *Leptocephali*.

Anguilla anguilla is found on the coasts and in the rivers of western Europe and the Mediterranean countries. It has an elongate, subcylindrical body, covered with small oblong scales embedded in the slimy skin, and arranged in little groups at right angles to each other; the mouth is terminal, with bands of pointed teeth; the back is greenish or brownish, the sides generally yellowish. The eels inhabit not only rivers and lakes but small brooks and isolated ponds; they are also found in harbours and estuaries and on muddy shores. They often burrow during the day and feed principally at night, eating any kind of animal food. A length of 5ft. and a weight of 20lb. may be reached. Towards the autumn some eels cease feeding and become silvery; the snout also becomes sharp, the eyes larger and the pectoral fins more pointed. These silver eels descend to the sea, and it has been established by Dr. Johannes Schmidt that they travel across the Atlantic to breed in an area south-east of Bermuda, and die after breeding. The transparent larvae, which have needle-shaped teeth, live near the surface of the ocean, and as they spread out across the Atlantic grow from about 10mm. to 75mm. long in about $2\frac{1}{2}$ years; the full-grown larvae occur off the Atlantic coast of Europe and in the western Mediterranean during the summer; they cease feeding, lose their larval teeth, shrink in depth and length, and change into the elvers, or little eels, which enter rivers in large numbers during the winter and spring. Scale investigations have shown that male eels assume their breeding dress $4\frac{1}{2}$ to $8\frac{1}{2}$ years after the elver stage, when they are 12 to 20in. long, and female eels usually after $6\frac{1}{2}$ to $8\frac{1}{2}$ years, when they are 14 to 26in. long; but larger females 3ft. long have lived $10\frac{1}{2}$ to $12\frac{1}{2}$ years since the elver stage. The silver eels have the flesh full of fat, and in the most important fisheries they are intercepted on their way to the ocean, as on the Bann, which runs out of Lough Neagh. Denmark has valuable eel fisheries, and at Commachio, on the Adriatic, eels are farmed in extensive brackish lagoons, the natural supply of elvers replenishing the stock. Schmidt's researches are of great economic importance, showing that for a particular fishery it is useless to allow silver eels to escape, as plenty from other regions will reach the breeding place. The American eel (*Anguilla chrysypa*) differs from the European eel chiefly in the fewer vertebrae, 104 to 110 instead of 111 to 118; it breeds in an area overlapping the breeding area of the European species, but extending westwards from it. It has a

shorter larval history, the elvers being one year old instead of three; this difference keeps the species distinct, for if larvae of the American eel travel east they change into elvers in the middle of the Atlantic, and those of the European eel going west reach America as small larvae. Other species of *Anguilla* are from Japan, Indian ocean and western Pacific. (*See* FISHES.) (C. T. R.)

EEL-GRASS or **GLASS-WRACK** (*Zostera*), the name applied to certain salt-water plants, growing on gently sloping shores in temperate regions. The lower part of the stem is creeping, the branches growing upwards and dividing. The leaves are long and narrow. Two of the six species are British and three occur off the shores of North America. The pollen grains have the same specific gravity as water, so that they float at any depth. *Zostera* belongs to the family Potamogetonaceae, which also includes the pond-weeds (*q.v.*).

EFFENDI, a title of respect, equivalent to the English "sir," in Turkey and some other eastern countries. It follows the personal name, when that is used, and is generally given to members of the learned professions and to government officials who have no higher rank, such as Bey, Pasha etc. It may also indicate a definite office, as *Hakim effendi,* chief physician to the sultan. The possessive form *effendim* (my master) is used by servants and in formal intercourse.

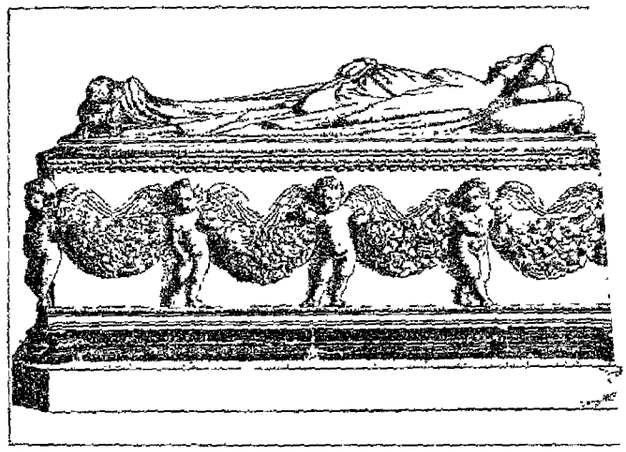
EFFIGIES, MONUMENTAL, a term usually associated with the figures carved in relief, or in the round, on the sepulchral monuments of the Christian era. However, close prototypes may be found on the Etruscan sarcophagi, which in some cases date as far back as the 6th or 5th century B.C. In the Flavian period, Ulpia Epigone is represented in relief in precisely the same manner as on Italian tombs of the 15th century. Portrait busts are found on the fronts of the early Christian sarcophagi, but full length carved effigies appear to be completely non-existent between the Roman period and the 11th century A.D. It is possible that royal, and perhaps some of the most important ecclesiastical effigies, were comparatively faithful portraits as early as the 14th century, but other effigies before the 15th century were probably made from stock workshop patterns. The details of costume seem to have been most carefully reproduced and form an extremely valuable contribution to our knowledge of the attire of the different periods. The materials used for the effigies varied, marble and bronze being used throughout Europe, stone and wood chiefly in the more northern countries, the latter being particularly well represented in England. Purbeck marble was largely used

THE WOODEN EFFIGY IN GLOUCESTER CATHEDRAL CHURCH CALLED ROBERT, DUKE OF NORMANDY, PROBABLY MADE ABOUT 1290

in England for the earlier figures, and alabaster during the 15th century.

Romanesque and Gothic.—The characteristic sepulchral monument throughout northern Europe in the 12th century is the flat slab tomb with the effigy in low, later in higher, relief. With the 13th century the base frequently takes the form of a sarcophagus, the decoration of which becomes gradually more elaborate and which is sometimes surmounted by an architectural canopy. Though horizontal, the figure in the earlier tombs is represented standing, but in the 13th century assumes a recumbent position, some of the earliest examples of the change being found in France. The upright position is, however, characteristic of the whole period in Germany.

Flat slab monuments are perhaps the most characteristic form throughout the Gothic period in Germany, those of the 14th century being well represented at Bamberg, and there is a long series of effigies, extending over several centuries, at Mainz. Slab tombs of the 12th century in France generally follow the same lines as in Germany but are much more rare. The m ments of the 13th and 14th centuries follow the usual dev



EFFIGY OF ILARIA DEL CARRETTO BY JACOPO DELLA QUERCIA, IN CATHEDRAL S. MARTINO IN LUCCA

ment, the effigy being treated in increasingly high relief and quently supported on a tomb chest with or without an arch tural canopy. Unfortunately the unrivalled series of royal eff at St. Denis have suffered severely from restoration but they form a most valuable record. The few remaining 12th cen tombs in England are of the usual slab form with the figu low relief, but the series of effigies of the 13th century, m carved in Purbeck marble, are exceptionally rich in quantity vigorous in style. A distinct group of effigies is that represe knights in chain-mail; after the middle of the century the are usually crossed but there seems to be no foundation for popular theory that this position indicates a crusader. A not group of such effigies is in the Temple church in London. Anc fine example is the wooden effigy, at Gloucester, called Ro Duke of Normandy (*c.* 1290). After the middle of the cen miniature chapels and shrines were frequently built up over tomb, a good example being the monument of Bishop Giles I port at Salisbury. The whole series of effigies, from the Romanesque to the end of the Gothic period form, both in r ber and variety, one of the most characteristic development English sculpture. The flat slab tombs of the 12th and 13th turies of northern Europe are not frequent in Italy. A characteristic type of mural monument was evolved by the mati school, chiefly in Rome, in the second half of the century; this shows the recumbent effigy on a high draped cophagus, frequently inlaid with mosaic, under an arched ca with, in most cases, a fresco or mosaic of the Virgin and C in the lunette. But to Arnolfo di Cambio (*c.* 1232–1300) is d very fine development of this composition, the monumen Cardinal de Braye at Orvieto, the prototype of the magnifi series of 15th century monuments, which are one of the gl of Italian art.

The Renaissance.—The long series of 15th and 16th cen tombs in Italy embrace some of the finest Italian figure sculp and they were frequently the work of the foremost artists of day. Few works of art are more moving than the lovely eff of Santa Justina by Agostino di Duccio (now at South Kensin museum, London), or of Ilaria del Carretto, at Lucca, this l by Jacopo della Quercia. The typical Tuscan form of the century is the mural monument showing the recumbent por effigy lying on a bier supported on a sarcophagus with a r of the Virgin and Child above in the lunette under the r arched frame. To the first quarter of the 16th century bel the masterpiece of late Renaissance monumental sculptur Italy, the tombs of the Medici by Michelangelo in San Lor at Florence. The two seated effigies are idealized figures r than portraits, but the whole conception is one of the no works of Italian art and one which exercised an overpow influence on most of the remaining tombs of the century

The style of the transitional Gothic Renaissance period

a.m. .. the magnificent tombs of Margaret
ilibert of Savoy (c. 1526–32) at Brou, by
se show the double effigies especially popular
of the 16th and 17th centuries though they
n the 15th century in England—above is the
the skeleton.

KNEELING FIGURE OF CARDINAL MAZARIN BY
THE LOUVRE). THE LOWER FIGURES REPRESENT
DELITY

f the 16th century some very elaborate free-
monuments were produced in France. The
hown kneeling or reclining as in life. A typi-
mural tomb with minutely characterized
he monument of the Cardinals d'Amboise at

HARFORD. BOSBURY, SIGNED BY JOHN GUIDO (OR
ED, 1573

: most magnificent of the huge free-standing
of Henry II. and Catherine de' Medici at St
y Germain Pilon. In England, the recumbent
ual form on tombs of the transitional Gothic-
l, the most characteristic type of monument
arge free-standing tomb chest without an archi-

Michelangelo's design for the Medici tombs
g factor in the monumental style of the 16th
Bernini's tombs of the popes at St. Peter's,
ristic for the 17th and 18th centuries.
tinct change comes over the treatment of the

effigy in the 17th century; hitherto
sented in repose, but with the 17t
matic feeling are aimed at. The to
bonne in Paris, by Girardon, with it
in point, as, too, is the gesticulatin
by Tuby at the Invalides. Really fi
like kneeling figure of Mazarin, by C

MONUMENT BY BERNINI TO POPE URBAN
PETER, ROME

the Louvre. The imposing but rather
century are well represented by the
the Polish queen, Opalinska, being
angel.

In Germany, the monumental scu
centuries shows neither distinction
monuments of the early part of the
free-standing tomb with recumbent
is still found, as in the tombs of Quee
of Scots, at Westminster Abbey (160

The Neo-Classical Revival.—T
sculpture in the last half of the 18th
simultaneous expression throughout
resented in Italy by the work of Can
by that of Flaxman (1755–1826) a
Thorwaldsen (1770–1844). (*See*
SCULPTURE.)

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gies in England and Wales (new rev.
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Esdaile, *English M* *Sculptur*

EFFINGHAM, a city of Illinois, U.S.A., midway between Terre Haute and Saint Louis, on Federal highways 40 and 45, and near the Little Wabash river; the county seat of Effingham county. It is served by the Illinois Central, the Pennsylvania and the Wabash railways. The population was 4,024 in 1920 (96% native white). It is the commercial centre of a rich farming and dairying region. Its principal manufactures are condensed milk, ketchup, canned vegetables and butchers' blocks. The city was settled about 1853 and incorporated in 1867.

EFFLORESCENCE, the evaporation of water of crystallization from a hydrate (*q.v.*) when it is exposed to ordinary air at ordinary temperatures; *e.g.*, washing soda loses part of its water of crystallization and forms a lower hydrate, as is shown by the powdery appearance of its surface.

EGAN, PIERCE (1772–1849), English sporting writer, was born in London. He was soon recognized as the best sporting reporter of his day. In 1814 he wrote, set and printed himself *The Mistress of Royalty*, about the prince regent and Miss Robinson. His best-known work is *Life in London* (1821), a book typical of the "fast" life of the day, illustrated by Cruikshank. It was one of Thackeray's early favourites (*see* his *Roundabout Papers*). It was much imitated, and dramatic versions were produced. A sequel more concerned with the country was perhaps what suggested *Pickwick Papers* and the *Jorrocks* books. Among his other books are *Boxiana* (1818), *Life of an Actor* (1824), Book of Sports (1832), and *Pilgrims of the Thames* (1838). He was an authority on slang and contributed to Grose's *Dictionary of the Vulgar Tongue* (1823).

EGEDE, HANS (1686–1758), Norwegian missionary, was born in the vogtship of Senjen, on Jan. 31, 1686. He studied at the university of Copenhagen, and in 1706 became pastor at Vaagen in the Lofoten islands. In 1721 he sailed to Greenland but found to his dismay that the Northmen were entirely superseded by the Eskimo. He converted many of them to Christianity, founded the colony of Godthaab and established a considerable commerce with Denmark. Ill-health compelling him to return home in 1736, he was made principal of a seminary at Copenhagen, in which workers were trained for the Greenland mission; and from 1740 to 1747 he was superintendent of the mission. Egede died on Nov. 5, 1758. He is the author of a book on Greenland (last ed. 1923, Eng. trs. 1745).

His work in Greenland was continued, on his retirement, by his son PAUL EGEDE (1708–1789), who afterwards succeeded his father as superintendent of the Greenland mission, and became professor of theology in the mission seminary. He published a Greenland-Danish-Latin dictionary (1750), Greenland grammar (1760) and Greenland catechism (1756). In 1766 he completed the translation begun by his father of the New Testament into the Greenland tongue; and in 1787 he translated Thomas à Kempis. In 1789 he published a journal of his life in Greenland.

EGER, AQIBA (1761–1837), Jewish scholar, and from 1812 rabbi of Posen. He was a rigorous casuist of the old school, and his chief works were legal notes on the Talmud and the code of Qaro (*q.v.*). He opposed the establishment of secular schools, and also the reform movement.

EGER (Czech, Cheb), is a large manufacturing town in western Bohemia, Czechoslovakia, on the right bank of the river Ohře. Situated about 1,500 ft. above sea-level, beneath a spur of the Fichtelgebirge, it lies in the centre of a German-speaking district and has a long history closely associated with its frontier position. The strategical value of the site is emphasized by the stormy nature of its record, for between the 12th and 14th centuries Bohemia and the Empire constantly struggled to possess the region in which it lies. To this period belong the ruined 12th century castle, lying on a height to the north-west of the town, where in 1634 Albrecht Wallenstein was murdered, and the imposing 13th century church of St. Nicholas. Final incorporation with Bohemia was effected in 1350 when Charles IV. united the two warring powers; but its position still influenced its history and the town suffered severely in the Hussite war, the Swedish invasions of the 17th century and the War of the Austrian Succession.

To-day it is a prosperous and important industrial centre with several textile factories, pottery and earthenware works, breweries, engineering and motor works. Pop. (1923), 27,524 of whom 23,125 are Germans.

EGER, the capital of the county of Heves in Hungary, is situated near the eastern foot-hills of the Mátra mountains, on the river Eger, a tributary of the Tisza. As the see of an archbishopric since 1814 it contains numerous ecclesiastical buildings and is known as "the Hungarian Rome." The cathedral in Italian style dates from 1831–34, but the ruined mosque and a Greek church indicate both the course of the history of the town and its situation near a religious frontier. The bishopric dated from 1010 and, as one of the richest in Hungary, was responsible for much of the early importance of the town which, in 1552, attracted the attention of the Turks who, after a long resistance, occupied it from 1596–1687. Its present activities are chiefly concerned with the preparation of Erlauer wine from the Mátra vineyards, with milling, soap and candle-making and the preparation of tobacco besides the usual work of an agricultural market-centre. The beautiful surroundings of the town are in harmony with its many fine ecclesiastical and municipal buildings, notably, in addition to those mentioned above, the observatory, lyceum and town-hall. Pop. (1920), 28,753.

EGERIA, the spirit or Lumpa (*see* NYMPHS) of a stream just outside the Porta Capena of Rome in the grove of the Camenae; also of a stream in the grove of Diana near Aricia. A wholly artificial story makes her the wife and counsellor of king Numa; they met in the grove of the Camenae, and on his death she retired to Aricia, where because of her lamentations Diana changed her into a stream. She was worshipped by pregnant women, and apparently as a prophetic goddess, in connection with Diana and the Camenae. She seems to have had a masculine counterpart Egerius, at Aricia.

See Wissowa, *Religion und Kultus*, 2nd ed. (1912), p. 248, and in Roscher, *Lexikon;* Buchmann, *De Numae regis Romanorum fabula* (1912), p. 38 ff.

EGFRITH (d. 685), king of Northumbria, succeeded his father Oswio in 671. He was married to Aethelthryth, daughter of Anna of East Anglia, who, however, took the veil shortly after Egfrith's accession, a step which possibly led to his long quarrel with Wilfrid archbishop of York. Egfrith married a second wife, Eormenburg, before 678, the year in which he expelled Wilfrid from his kingdom. Early in his reign he defeated the Picts who had risen in revolt. Between 671 and 675 Egfrith defeated Wulfhere of Mercia and seized Lindsey. In 679, however, he was defeated by Aethelred of Mercia, who had married his sister Osthryth, on the river Trent. Egfrith's brother Aelfwine was killed in the battle, and the province of Lindsey was given up when peace was restored at the intervention of Theodore of Canterbury. In 684 Egfrith sent an unsuccessful expedition to Ireland under his general Berht. In 685 he led a force against the Picts, was lured into their mountain fastnesses and slain at Nechtanesmere (now Dunnichen) in Forfarshire. Bede dates the beginning of the decline of Northumbria from his death. He was succeeded by his brother Aldfrith.

See Eddius, *Vita Wilfridi* (Raine, *Historians of Church of York*, Rolls Series, 1879–94), 19, 20, 24, 34, 39, 44; Bede, *Hist. Eccl.* (ed. Plummer, 1896), iii. 24, iv. 5, 12, 13, 18, 19, 21, 26.

EGG, AUGUSTUS LEOPOLD (1816–1863), English genre painter, was born on May 2, 1816, in London, the son of a gunmaker. He was a pupil of Henry Sass, and then studied at the Royal Academy; he became R.A. in 1860. He travelled in Italy with Dickens and Wilkie Collins in 1853. Egg was an excellent actor and played in Dickens's company of amateurs; one of his best parts was as John Want in Collins's *Frozen Deep*. He was famous in his day for small anecdotal pictures, of which the London public galleries possess several examples. He died at Algiers on March 26, 1863.

Among his principal pictures may be named: 1843, the "Introduction of Sir Piercie Shafton and Halbert Glendinning" (from Scott's *Monastery*); 1846, "Buckingham Rebuffed"; 1848, "Queen Elizabeth discovers she is no longer young"; 1850, "Peter the Great sees Catharine for the first time"; 1854, "Charles I raising

[illegible] L[illegible] and [illegible] from [illegible] a [illegible]ple picture [illegible] 1859, the "Night before Naseby"; 1860, his [illegible] exhibited work, the Dinner Scene from *The Taming of the Shrew*.

EGG, the female reproductive cell or ovum of animals, which gives rise generally only after fertilization to a new individual. The largest eggs are those of birds; this because, to the minute essential portion of the egg, or germ, from which the young bird grows there is added a large store of food-material—the yolk and white of the egg—destined to nourish the growing embryo, while the whole is enclosed within a hard shell.

The relative sizes of eggs depend on the amount of the food-yolk thus enclosed; while the form and texture of the outer envelope are determined by the nature of the environment to which the egg is exposed. Where the food material is infinitesimal in quantity the egg is either not extruded—the embryo being nourished by the maternal tissues—or passes out of the parental body and gives rise at once to a free-living organism or "larva," as is the case in many types of lowly freshwater and marine animals.

The number of eggs periodically produced by any given individual depends on the risks of destruction to which they, and the young to which they give rise, are exposed; not more than a single egg being annually laid by some species, while with others the number may amount to millions.

Birds' Eggs.—The egg of the bird affords the readiest example of the modifications imposed by the external environment. Since it must be incubated by the warmth of the parent's body, the outer envelope is a hard shell to protect the chick from pressure, while the dyes which commonly colour the surface of this shell may serve to hide it from egg-eating animals.

Carbonate of lime forms the principal constituent of the shell. In section, it will be found to be made up of three crystalline layers, traversed by vertical canals, whereby it is made porous to admit air to the developing chick.

The outermost layer is often a glaze, as in the ostrich, or it may assume the character of a thick, chalky layer as in some cuckoos (*Guira, Crotophaga*), cormorants, grebes and flamingoes; while in some birds as in the auks, gulls and tinamous, this outer layer is wanting: yet the tinamous have the most highly glazed eggs of all birds, the second layer of the shell developing a burnished surface.

While some birds' eggs have the shell so thin as to be translucent, *e.g.*, kingfisher, others display considerable thickness, the maximum being reached in the egg of the extinct *Aepyornis*.

Though in shape differing little from that of the familiar hen's egg, certain well-marked modifications of form are to be met with. Thus the eggs of the plover are pear-shaped, of the sand-grouse cylindrical, of owls and titmice spherical and of grebes biconical.

In coloration birds' eggs present a remarkable range. The pigments to which this is due have been shown, by their absorption spectra (Sorby, *Proc. Zool. Soc.*, 1875), to be seven in number. While many eggs are colourless or of one uniform tint, the majority present spots or lines, or both, of varying tints, the pigment being deposited as the egg passes down the lower portion of the oviduct. That the egg during this passage turns slowly on its long axis [illegible] lines have com[illegible] [illegible]kings are made [illegible] outlines, move[illegible] [illegible]iform, the large [illegible] Many eggs [illegible] to the strongly [illegible] in a d[illegible]per layer of the shell, [illegible]

[illegible] intensity of this [illegible]ain point, when [illegible] where but two [illegible] sometimes on the [illegible] other colourless. But [illegible] the full comple-ment in a nest is called no two are exactly alike they commonly [illegible] resemblance. Among certain species, however, which lay several eggs, one of the number differs markedly from the rest, as in the eggs of the house sparrow. In variability the eggs of the guillemot (*Uria troile*) exceed all others; both in the hue of the ground colour and in the form of the superimposed markings, these eggs exhibit a range for which no adequate explanation has yet been given. Individual peculiarities of coloration are commonly reproduced, not only with this species but also in others, year after year.

Significance of Colour.—The coloration of the egg bears no relation to that of the bird which lays it; but it may bear a more or less direct relation to the nature of the environment during incubation. White eggs may generally be regarded as representing the primitive type, since they agree in this with the eggs of reptiles. And it will usually be found that eggs of this hue are deposited in holes or in domed nests. This is because coloured eggs would be invisible in dimly lighted chambers, and therefore constantly exposed to the risk of being broken by the sitting bird, or rolling out of reach where the chamber was large enough to admit of this, whereas white eggs are visible so long as they can be reached by the faintest rays of light. Birds which have reverted to the more ancient custom of nesting in holes after having developed pigmented eggs (*e.g.*, puffins) cover the pigmented surface of the shell with a light-reflecting chalky incrustation.

Eggs deposited on the bare ground are usually protectively coloured. The eggs of the plover tribe afford striking examples.

But the majority of birds deposit their eggs in a more or less elaborately constructed nest, and in such cases the egg, far from being protectively coloured, often displays tints that would appear rather to attract attention; bright blue or blue spotted with black being commonly met with. It may be, however, that coloration of this kind is less conspicuous than is generally supposed, but in any case the safety of the egg depends less on its coloration than on the harmony of the nest.

The size of the egg depends partly on the number produced, on its surroundings and on conditions determining the state of the young at hatching; hence great disparity in the relative sizes of the eggs of different birds. Young birds which emerge blind, naked and helpless are the product of relatively small eggs, while young hatched from relatively large eggs are down-clad and active from birth.

The fact that the eggs must be brooded by the parent is also a controlling factor in so far as number is concerned, for no more can be hatched than can be covered by the sitting bird. Other less understood factors, however, also exercise an influence. Thus the ostrich lays 12 to 16, the teal 15, the partridge 12–20, while among many species the number is strictly limited, as in the hornbills and guillemots, which lay a single egg, the apteryx, divers, petrels, and pigeons never lay more than two, while gulls and plovers never exceed four. Tropical species are said to lay fewer eggs than their representatives in temperate regions.

Partly owing to the uniformity of shape, size and texture of the shell, birds' eggs are by no means easy to identify, except in so far as their family resemblances are concerned; that is to say, except in particular cases, they cannot be specifically distinguished, and hence they are of little value for classification.

Save among the megapodes, all birds brood their eggs, the period of incubation varying from 13 days in small passerine birds, to eight weeks in the cassowary. Megapodes deposit their eggs in mounds of decaying vegetable matter or in sand in the neighbourhood of hot springs, and there leave them. Where the nestling is active from the moment of hatching, the eggs have a relatively longer incubation period than in cases where the nestlings are for long helpless.

Eggs of Mammals.—Only in the *Echidna* (*q.v.*), and the duck-billed platypus (*q.v.*), among the Mammalia, are the eggs provided with a large store of yolk, enclosed within a shell and extruded to undergo development apart from the maternal tissues. In *Echidna* the eggs, two in number, are about as large as those of a sparrow, similar in shape, and have a white, parchment-like shell. After expulsion they are transferred by the beak of the mother

to a pouch resembling that of the kangaroos and there develop The platypus lays two to four eggs which in size and general appearance resemble those of the *Echidna*. They are, however, deposited in a loosely constructed nest at the end of a long burrow and there brooded. In Marsupials, the eggs, which are never extruded, are smaller than those of *Echidna* and the platypus, but contain a larger proportion of yolk than occurs in higher mammals.

Eggs of Reptiles.—The eggs of reptiles are invariably provided with a large amount of food-yolk and enclosed with a firm shell, which though generally parchment-like in texture may be calcareous as in birds, *e.g.*, many of the tortoises and turtles and the crocodiles. The egg is white or yellowish, while the number laid often far exceeds that in birds. The tuatara of New Zealand, however, lays but ten—white hard-shelled, long and oval—at intervals between November and January. The long intervals between the appearance of the successive eggs is a characteristic feature of the reptiles, but is met with among the birds only in the megapodes, which, like the reptiles, do not incubate their eggs.

The eggs of the lizards are generally soft-shelled; but the geckos and the green lizard lay hard-shelled eggs. Many of the soft-shelled eggs increase in size after extrusion, owing to the stretching of the membranous shell by the growing embryo. Lizards are less prolific than many chelonians, a dozen eggs being the general number, though as many as 30 may be produced at a time, as in the common chameleon.

While as a rule the eggs of lizards are laid in burrows or buried, some are retained within the body of the parent until the young are ready to emerge; or may even hatch within the oviduct. This occurs with some chameleons and some lizards, *e.g.*, the common English lizard. Normally the young leaves the egg immediately after its extrusion, but if this is delayed it escapes while yet in the oviduct.

The majority of snakes lay eggs, but most vipers and aquatic snakes are viviparous. The shell is always soft and parchment-like. As a rule the number of eggs produced is not large—20 or 30 being common—but some pythons lay as many as a hundred. Generally, among oviparous snakes the eggs are buried, but some boas jealously guard them, enclosing them within the coils of the body.

Eggs of Amphibia.—Among the Amphibia a greater variety obtains in the matter of the investment of the egg, as well as in the number, size and method of their disposal. The outer covering is formed by a toughening of the surface of a thick gelatinous coat which surrounds the essential parts of the egg.

Viviparity occurs among the limbless and the tailed Amphibia, the eggs hatching before they leave the oviduct or immediately after extrusion. The number of young so produced is generally not large, but the common salamander (*Salamandra maculosa*) may produce as many as 50 at a birth, though 15 is the more normal figure. When the higher number is reached the young are relatively small and weak.

As a rule the young leave the egg as larvae ("tadpoles"); but many species produce eggs containing sufficient food material to enable the whole larval phase to be completed before hatching.

Among the tailless Amphibia (frogs and toads) there are wide differences in the number of eggs produced, while the methods by which these eggs are disposed of present a marvellous variety. As a rule vast quantities of eggs are shed by the female into the water in the form of "spawn." In the common toad as many as 7,000 eggs may be extruded at a time. These leave the body in two long strings—one from each oviduct—of translucent globules, gelatinous in texture, and enclosing a central sphere of yolk, the upper pole of which is black. The spawn of the common frog differs from that of the toad in that the eggs adhere to form a jelly-like mass. But in many species the number of eggs produced is few; and these may be sufficiently stored with food-yolk to allow of the tadpole stage being passed before hatching, as in frogs of the genus *Hylodes*. In many cases the eggs are deposited out of the water and often in remarkable ways. In *Phyllomedusa* the edges of two leaves of a willow overhanging the water are fastened together and the eggs poured into the bag thus formed. The larvae emerging drop into the water. In the midwife toad (*Alytes*) the eggs are carried about on the hind legs of the male In the pouched frog, the eggs are carried in a pouch on the back of the female; and in the Surinam toad (*Pipa*) the eggs become embedded in the back of the female, the larval stage being passed within the egg.

Eggs of Fishes.—The eggs of fishes present a wide range both of form, and of number. Most sharks and rays are viviparous but in the oviparous species the eggs present some peculiar forms Large in size, the outer coat or "shell" is horn-like and flexible but varies greatly in shape. Thus in the egg of the larger spotted dog-fish it is oblong, flattened from side to side, and has the angles produced into long, slender tendrils. As the egg is laid the lower tendrils project from the vent, and the mother rubs herself against some fixed body. The tendrils catch in some projection when the egg is dragged forth to remain till hatching. A couple of narrow slits at each corner of the upper end admit fresh water to the embryo during the later stages; when development is complete escape is made through the end of the shell. In the rays, long spines take the place of tendrils, the egg simply resting at the bottom of the sea. The empty egg-cases of the rays are often found on the seashore and are known as "Mermaids' purses."

Among the bony fishes the eggs generally take the form of small spheres, enclosed within a tough membrane or capsule. But they present important differences, some being heavy and remaining at the bottom of the water, others light and floating on the surface; in some species they are distributed separately, in others, they adhere together in masses. The eggs of the salmon, for example, are heavy, hard and smooth, and deposited separately in a trough dug by the parent and afterwards covered to prevent them from being carried away by the stream. In the perch they are adhesive and form long band-like masses of spawn adhering to water plants. In the gobies the egg is spindle-shaped, and attached by one end by means of a network of fibres, resembling rootlets; while in the smelt it is loosely suspended by a membrane formed by the peeling off of part of the outer sheath of the capsule. The eggs of the garfish (*Belone vulgaris*) and of the flying-fish (*Exocoetus*), attach themselves to foreign objects, or to one another by threads developed at opposite poles.

In many fishes the eggs float at the surface of the sea, often in enormous masses, when they are carried about at the mercy of tides and currents. An idea of the size which such masses attain may be gathered from the fact that the spawn of the angler-fish, *Lophius piscatorius* is a sheet 2 to 3ft. wide, and 30ft long Another remarkable feature of these floating eggs is their transparency, and hence they probably escape spawn-eating animals. The cod tribe and flat-fishes lay floating eggs of this description.

The maximum number of eggs laid by fishes varies greatly, but in all cases the number increases with the weight and age of the fish. Thus it has been calculated that the number laid by the salmon is roughly about 1,000 to every pound weight of the fish. The sturgeon lays about 7,000,000; the herring 50,000; the turbot 14,311,000; the sole 134,000; the perch 280,000. Briefly, the number is greatest where the risks of destruction are greatest.

The eggs of the lampreys and hag-fishes—creatures more primitive than the true fishes—are remarkable; in the latter they are large, cylindrical, and provided at each end with hooklets whereby they adhere one to another; while in the lampreys they are small and embedded in jelly.

Molluscs.—Among the Mollusca, Crustacea and Insecta yolk-stored eggs of remarkable forms are produced.

In variety, in this connection, the Mollusca must perhaps be given the first place. This diversity is illustrated by the eggs of the Cephalopoda. In the squids (*Loligo*), the eggs are enclosed in long cylindrical cases, of which there are several hundreds, attached by one end to a common centre; the whole series looking like a rough mop-head. Each case, in such a cluster, contains about 250 eggs, or about 40,000 in all. By way of contrast the eggs of the cuttle-fish (*Sepia*) are deposited separately, each enclosed in a tough, black, pear-shaped capsule which is fastened by a stalk to fronds of sea-weed or other object They to be

extruded at short intervals, till the full complement is laid, the whole forming a cluster looking like a bunch of grapes. The octopus differs again, its eggs being small, berry-like, and attached to a stalk which runs through the centre of the mass.

The eggs of the univalve Mollusca are hardly less varied. In the common British *Purpura lapillus* they resemble delicate pink grains of rice set on stalks; in *Busycon* they are disc-shaped, and attached to a band nearly 3ft. long. The eggs of the shell-bearing slugs (*Testacella*) are large, and have the outer coat so elastic that if dropped on a stone floor, they will rebound several inches; while some of the snails (*Bulimus*) lay eggs having a white calcareous and slightly iridescent shell in size and shape resembling the egg of the pigeon. The beautiful marine violet-snail (*Janthina*) carries its eggs on the under side of a gelatinous raft. The eggs of the whelk, like those of the squids, are enveloped in capsules, and these to the number of many hundreds form the large, ball-like masses commonly met with on the seashore.

With the Mollusca, as with other groups where the eggs are exposed to great risks, they are small, produced in great numbers, and give rise to larvae. Thus the common oyster annually disperses about 60,000,000 eggs. But where the risk of destruction is slight, the eggs are large and produce young differing from the parent only in size, as in the pigeon-like eggs of *Bulimus*.

Crustaceans.—Among the higher Crustacea, as a rule, the eggs are carried by the female, attached to special appendages on the under side of the body. But in some—Squillas—they are deposited in burrows. Generally they are small so that the young which emerge therefrom differ markedly in appearance from the parents, but in deep-sea and freshwater species the eggs are large, when the young, on emerging, differ little from the adults in appearance.

Insects, etc.—The eggs of insects though minute, are also remarkable for variety of form, while they are frequently objects of great beauty owing to the sculptured markings of the shell. They are generally laid in clusters on the ground, on the leaves of plants, or in the water. Some of the gnats (*Culex*) lay them on the water. Cylindrical in shape they are packed closely together, set on end, the whole mass forming a floating raft. Frequently, as in the stick and leaf insects, the eggs are enclosed in capsules of elaborate shapes and highly ornamented.

The eggs of butterflies and moths present a surprising range of variety in shape, sculpturing and coloration. As to the rest of the Invertebrata—above the Protozoa the eggs are laid in water, or in damp places. In the former case they are as a rule small, and give rise to larvae; while eggs hatched on land are sometimes enclosed in capsules, "cocoons," as in the earthworm, in which case this capsule is filled with a milky nutritious fluid on which the embryos feed.

Among some invertebrates two different kinds of eggs are laid. The water-flea, *Daphnia* (a crustacean), lays two kinds known as summer and winter eggs. The summer eggs are carried by the female in a brood-pouch on the back. The winter eggs, produced at the approach of winter, differ markedly in appearance from the summer eggs, being larger, darker in colour, thicker shelled, and enclosed in a capsule formed from the carapace of the parent's body. Winter eggs, however, may be produced in the height of summer. While the summer eggs are unfertilized, the winter eggs are fertilized by the male, and may lie dormant for months or even years before they develop. The production of these two kinds of eggs is a device to overcome the cold of winter, or the drying up of the pools in which the species lives, during the heat of the summer. The power of resistance such eggs possess may be seen in the fact that a sample of mud which had been kept dry for ten years still contained living eggs. In deep water where neither drought nor winter cold can seriously affect *Daphnia*, it propagates all the year round by unfertilized summer eggs.

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EGG AND DART MOULDING, in architecture, a decorated moulding (*q.v.*), in which the convex portion is carved with egg-shaped forms in raised frames, alternating with long, narrow raised, dart shapes. The egg and dart is a Greek development from the Egyptian and west Asiatic tri-lobe lotus, the dart being the central of the three petals, and half the frame of each of the two adjoining eggs representing the curved side petals. In fact certain Egyptian bands in which lotus flowers and lotus buds are alternated, have identically the same rhythmic composition as the egg and dart. At first using it as a painted horizontal band, the Greeks came later to employ it as a moulding decoration, and carved it in deep relief. It has remained one of the most popular moulding decorations through all the classic styles.

EGG COOKERY. Eggs are valuable food, containing proteids, fat, salts (notably iron), water and small quantities of carbohydrates. They also contain "a" and "b" vitamins. The white is almost pure albumin dissolved in water and thus blends, when raw, with cold water. The yolk has a high content of fat in the form of oil and also lecithin, an important substance useful for nourishing nerves and for aiding growth. The shell consists chiefly of calcium carbonate and is more or less porous, therefore eggs will not keep unless the shell is hermetically sealed. Raw eggs are easier to digest than cooked ones, and lightly cooked eggs are digested better than those which are subjected to long cooking or great heat, which renders them tough, as albumin coagulates slightly at 134° F and is wholly coagulated at 160° F.

Various kinds of eggs are used in cookery. Hens' eggs are those most commonly eaten but ducks' eggs contain more fat. Plovers' eggs are usually regarded as a delicacy, while those of other birds, turtle and terrapin eggs are eaten in different parts of the world. Eggs have many uses in cookery. The whites are employed as clarifying agents for soups, jellies and sugar, etc., and for making meringues; and the whole egg is used as a gum-like agent in coating foods with crumbs, etc., for frying and baking; it is also a binding medium or leavening agent in such foods as mushes, rissoles, cakes, etc. Again in invalid cookery (*q.v.*) eggs form a very large part of the ingredients; raw eggs and crackers for instance, make a complete meal, while egg drinks furnish a nutritive liquid food. In addition, egg blends with almost all kinds of foods and adds to the richness of dishes. Hard-cooked eggs are also used as garnishes for salads and vegetable dishes. Egg dishes should be very carefully prepared. Over-heating and the addition of foods containing acids, if insufficiently blended with the eggs, will cause curdling. Where starch is an ingredient greater heat can be applied than if plain eggs are used. When it is desired to achieve a "spongy" effect in cakes or soufflés, etc., add the whites and yolks separately, folding the whites in last of all, immediately before cooking, so that they have not time to fall. If acids are mixed with eggs, a thorough beating should be given in order to froth the mixture, in this way effecting complete blending of egg and acid.

In cooking eggs whole, the simplest method is coddling; much depends on the freshness of the egg. A newly-laid egg should be placed in boiling water and allowed to remain at simmering point for 3 to 4 minutes. If a hard-cooked egg is required, allow 20 to 30 min. in order to produce a floury texture. To poach an egg, have ready a shallow oiled pan with salted water and a few drops of vinegar or lemon juice to keep the white from spreading. Spoon the white over the top of the egg so that the yolk is entirely covered. A muffin ring or egg poacher is a great help in keeping the shape of a poached egg. Fried eggs are cooked in hot bacon or other fat until set. Baked or steamed eggs are cooked in small buttered receptacles with or without other foods. Lightly or well-beaten eggs are used in a large number of dishes e.g. scrambled eggs (beaten and stirred with butter and occasionally

milk), omelettes with other foods. in batter for frying, in preparing soufflés, etc.

Dried or desiccated eggs are occasionally used in place of fresh eggs, but must be mixed with water and allowed to soak before cooking (*see* PRESERVING AND BOTTLING). (J. A. SI.)

EGGENBERG, HANS ULRICH VON, PRINCE (1568–1634), Austrian statesman, was a son of Siegfried von Eggenberg (d. 1594), and began life as a soldier in the Spanish service, becoming about 1596 a trusted servant of the archduke of Styria, afterwards the emperor Ferdinand II. He was soon the chancellor and chief adviser of Ferdinand, whose election as emperor he helped to secure in 1619. He directed the imperial policy during the earlier part of the Thirty Years' War, and was in general a friend and supporter of Wallenstein, and an opponent of Maximilian I., duke of Bavaria, and of Spain. He died at Laibach on Oct. 18, 1634. Eggenberg's influence with Ferdinand was so marked that it was commonly said that Austria rested upon three hills (*Berge*): Eggenberg, Questenberg and Werdenberg. He was made a prince of the Empire in 1623 and duke of Krumau in 1625.

See H. von Zwiedineck-Südenhorst, *Hans Ulrich, Fürst von Eggenberg* (Vienna, 1880); and F. Mares, *Beiträge zur Geschichte der Beziehungen des Fürsten J. U. von Eggenberg zu Kaiser Ferdinand II. und zu Waldstein* (Prague, 1893).

EGGLESTON, EDWARD (1837–1902), American writer, was born in Vevay (Ind.), Dec. 10, 1837, of Virginia and Kentucky stock. Because of his father's early death and his mother's re-marriage the family moved to New Albany and to Madison, and he himself spent some time with relatives in Virginia and southern Indiana, living through the "sharp contrasts of corn-shuckings and camp-meetings, of wild revels followed by wild revivals" which he later described. Before he was nineteen, he had chosen as his own the heroic frontier profession of circuit rider, but within six months the toils and hardships involved broke down his health. After a stay in the Minnesota pine woods to recuperate, he held pastorates in St. Paul and elsewhere in the Minnesota Methodist Conference for several years, and in later life (1874–79) was minister of the Church of Christian Endeavour in Brooklyn. The remainder of his time was spent in literary work as associate editor of the *Little Corporal* (1866–67), a juvenile paper, and editor of the *National Sunday School Teacher* (1867–70), in Chicago; for a short period as literary editor and later editor-in-chief of the *Independent* and editor of *Hearth and Home* in New York; and during the latter part of his life in retirement at his home on Lake George (N. Y.). He died Sept. 4, 1902.

In all of his work he was true to his early ideal—to write with "photographic exactness" of the real West. The earliest of his books for adults, *The Hoosier Schoolmaster* (1871), is also the best known, a vivid study of the backwoods Hoosiers, which was translated into French, German, Dutch and Danish. *The End of the World* (1872) has as its theme the expectation of the end of the world about the middle of the 19th century; *The Mystery of Metropolisville* (1873) portrays a typical Minnesota boom town; *The Circuit Rider* (1874), less a novel than a series of sketches, contributes to our knowledge of frontier religious phenomena; *Roxy* (1878) illuminates politics on the border, *The Graysons* (1888), a good novel, shows Abraham Lincoln as a young lawyer in Illinois. *The Faith Doctor* (1891), *Duffels* (1893) and the children's books are of less significance.

Since Eggleston constantly stressed the fact that "no man is worthy to be called a novelist who does not endeavour with his whole soul to produce the higher form of history, by writing truly of men as they are, and dispassionately of those forms of life that come within his scope," it was but natural that he should turn near the end of his life to the writing of pure history. Although he produced several popular compendiums for school and home, he lived to complete only two volumes of his projected *History of Life in the United States—The Beginners of a Nation* (1896) and *The Transit of Civilization* (1900). As a pioneer in the field of social history, he deserves credit. Some of his novels have faults of exaggeration and structure, but as a first-hand picture of a phase of life that has long since passed away and as an antidote to the thrilling concoctions of the dime novelist they will long be important.

See Meredith Nicholson, *The Hoosiers* (1900) and his article in the *Atlantic Monthly*, vol. xc.; G. C. Eggleston, *The First of the Hoosiers* (1903), also an autobiographical article in the *Forum* (Nov. 1890).

EGG-PLANT (*Solanum Melongena*), a perennial plant of the nightshade family (Solanaceae), closely allied to the potato, and known also as egg-fruit, aubergine and guinea-squash. It is probably a native of southern Asia, where since remote antiquity it has been cultivated for its fleshy fruit used as a vegetable. For this purpose it is usually grown as an annual. It has an erect, bushy, rather scurfy stem, sometimes armed with a few spines, and large ovate, slightly lobed leaves, and nodding, violet, usually solitary flowers, about 2 in. across. The fruit is a large, pendent, egg-shaped, oblong or somewhat pear-shaped berry, varying in length from 2 in. to 12 in., dark purple, white or yellowish in colour, sometimes striped, and with a shining surface. The snake egg-plant is a curious variety (var. *serpentinum*) with very narrow, elongated fruit, sometimes a foot long and curled at the end. The dwarf egg-plant (var. *depressum*) is a small, nearly smooth and spineless form, with nearly entire leaves and purple fruit about 4 in. long. In the southern United States egg-plant is extensively grown in kitchen gardens for home consumption and also as a market crop, the total value of which in 1926 amounted to $935,000. (*See* AUBERGINE.)

EGGS. In a number of countries an attempt is made to enumerate the stock of poultry but it is evident that the result can only be roughly approximated and that returns of the number of eggs would be still more untrustworthy.

In Great Britain returns were obtained, for the first time, in 1908 of the number of poultry kept on agricultural holdings, and similar returns have been collected at intervals in later years. In the special enquiry made in 1925 in connection with the Census of Production Act (*see* AGRICULTURE, CENSUS OF) the Ministry of Agriculture endeavoured also to obtain particulars of egg production on farms. Occupiers owning about 20 per cent of the fowls on agricultural holdings furnished particulars of egg production. On the basis of these returns it was calculated that the number of eggs produced on farms in England and Wales was 1,458 millions. Large numbers of fowls are kept by private persons outside agricultural holdings, and it is estimated that one-third should be added to allow for this supply. The total number of hen's eggs would thus reach nearly 2,000 millions. The production of duck's eggs is estimated at 43 millions.

Great Britain has long been an importer of eggs. As far back as 1710 there was a duty on imported eggs which was from time to time increased from 2d. per "long hundred" (120) to 10d in 1853, when it was reduced to 4d and was finally abolished in 1860. At that time the imports amounted to about 2 million eggs.

In 1870 the imports had increased to 431 millions and thereafter rose steadily, decade by decade, up to the time of the World War, thus:—

1880	747	1900	2025
1890	1235	1913	2590

After the trade began to recover from the effects of the World War the total rose to 1,639 millions in 1922. In 1927 the total reached 2,921 millions, but as supplies from the Irish Free State, which, before 1923, were regarded as home produce, have since that date been treated as imports, the figure is not comparable. The imports from the Irish Free State in 1927 amounted to 606 millions, so that the total comparable with that prior to 1923 is 2,315 millions.

Preserved eggs are not distinguished in the returns but it may be assumed that fresh eggs are mostly subjected to some form of preservative process for shipment. In many cases, as in this country, surplus supplies in the season of greatest plenty are "pickled" for a time and sent forward when fresh supplies are smaller.

British Supplies.—The chief British sources of supply and the quantity in "long hundreds" received from each in 1927 are shown in the following table:—

Denmark	5,679,640
Irish Free State	5,051,525
[illegible]	2,587,956
Netherlands	2,359,895
China	688,183
Egypt	668,544
France	429,509
Above and other countries (total)	24,347,523

There is also a large British importation of eggs not in shell—i.e., egg albumen and yolk, dried eggs and egg powder. In 1927 the total quantity imported was 55,000 tons, of which nearly 98% came from China. These products are used in various industrial processes and also, to some extent, in the confectionery and baking trades.

Before the war more than 50% of the eggs, in shell, imported into the United Kingdom came from Russia. That country, as will be seen from the table above, does not now appear among the chief contributing countries shown in the trade returns, and does not in fact send more than 5% of the total. It should be noted, however, that about 11% of the pre-war supplies came from Poland, Latvia and Lithuania which were then included in Russia, while Estonia and Finland, formerly part of Russia, also sent quotas.

Calculations of egg consumption can only be approximate. In Great Britain the imports, which are accurately recorded, amount (excluding eggs not in shell) to one egg per week per head of the population, and it is estimated that the home supplies would be about equal. On this basis the consumption works out to approximately 110 eggs per annum per head of the population.

Similar calculations give the following estimated annual consumption per head in various countries as follows: Canada, 313; Belgium, 213; U.S.A., 180; France, 133; Germany, 117; Sweden, 95; Denmark, 75; Norway, 61.

A great impetus has been given to poultry-keeping in recent years both by improving the breed of fowls and by adopting better systems of management. A hindrance to increased consumption has been the unreliability of a large proportion of the home supply of eggs and the lack of organized marketing. Active steps are now being taken to remedy these defects and to place British eggs on an equality with their imported rivals in regard to regularity of supply and reliability of quality. (R. H. R.)

United States.—The United States ranks first among all countries in egg production. Farm chicken egg production in 1879 amounted to 456,911,000 doz. eggs and increased to 1,293,662,000 doz. in 1899, 1,654,045,000 doz. in 1919 and to 1,913,245,000 doz. in 1924. These totals, based on census figures, do not include eggs produced on premises not classed as farms or the eggs of poultry other than chickens.

Eggs are produced in every county and on nearly 90% of all the farms in the United States. Specialized egg farming has been increasing rapidly in the last few years, but the eggs from such farms still constitute only a small proportion of the total production. General farm flocks are the source of much the greater part of the production, more than 50% of all eggs coming from the East North Central and the West North Central States, where the farm flocks greatly predominate. Specialized egg farms are most common in the Atlantic coast States, in close proximity to the large consuming markets, and in the Pacific coast States, where climatic conditions are especially favourable.

Eggs produced in the United States are used largely within the country. There is, however, some export business of eggs in the shell. It amounted in 1927 to 28,707,000 dozen. These eggs are shipped mainly to Canada, Cuba and Mexico, with fairly regular quantities going to South American countries, notably Argentina. Smaller quantities of egg products in the form of frozen, dried and canned eggs and egg yolks are also exported, these amounting in 1927 to about 660,000 pounds.

Imports of shell eggs are small, amounting to about 250,000 doz. in 1927. Imports of egg products are much greater, amounting [illegible] frozen [illegible] dried yolks [illegible] frozen yolks [illegible] frozen [illegible] or [illegible] The shell eggs imported come principally from Canada, while China furnishes the great bulk of the frozen and dried egg products. (R. R. Sl.)

EGHAM, a town in the Chertsey parliamentary division of Surrey, England, on the Thames, 21 m. W.S.W. of London on the Southern railway. Pop. of urban district (1921) 13,725. The church of St. John the Baptist is a reconstruction of 1817; it contains monuments by John Flaxman. Above the right bank of the river a low elevation, Cooper's hill, commands fine views over the winding river valley, and over Windsor Great Park to the west. On the hill was the Royal Indian Civil Engineering college, commonly called Cooper's Hill college. Cooper's hill also gave its name to a famous poem of Sir John Denham (1643). A large and handsome building, surrounded by extensive grounds, houses the Royal Holloway College for Women (1886), founded by Thomas Holloway. In the neighbourhood is the sanatorium of the same founder (1885) for the treatment of mental ailments. Within the parish, bordering the river, is the famous field of Runnymede, with the eyot or small island of Magna Charta lying off it in the stream (but situated in Buckinghamshire). The parish also includes the picturesque grounds and artificial lake of Virginia Water at the south end of Windsor Park, formed *c.* 1750, by the brothers Thomas and Paul Sandby.

EGILL SKALLAGRIMSSON (*c.* 900–983), an Icelandic skald, was forced to emigrate by Harold Fairhair, and after some years in the service of the English king, Aethelstan, returned to Norway, and took revenge by killing the son of Erik Blódöx in 934. Later he gained the favour of the king by his poem, *Höfudhlausn* (partial Swedish trans. by Sörenssen in 1866 and by Åkerblom in 1899).

His other works include the sagas *Sonatorrek*, *Arinbjarnardrápa* (Swedish trans. by Björlin in 1864) and *Skjaldardrápa*. The well known Icelandic poem, *Egill's Saga*, has been edited by F. Jónsson (Copenhagen, 1886; 2nd ed., 1924; Eng. trans., 1893). Some critics attribute it to Snorri Sturlason, *e.g.*, A. Bley, *Eigla-Studien* (Ghent, 1909). *See* also F. Khull, *Die Gesch. des Skalden E. Skallagrimsson* (1888).

EGIN or **KEMALIEH,** a kaza in the Mamuret el-Aziz vilayet of Asiatic Turkey (altitude 3,300 ft.). Pop. (1927) 22,975. It is picturesquely situated in a theatre of lofty, abrupt rocks, on the right bank of the western Euphrates, which is crossed by a wooden bridge. The stone houses stand in terraced gardens and orchards, and the streets are mere rock ladders. Egin was settled by Armenians who emigrated from Van in the 11th century with Senekherim.

EGLANTINE has been the subject of much discussion, both as to its exact meaning and as to the shrub to which it properly belongs. (*See* R. C. A. Prior: *Popular Names of British Plants.*) The eglantine of the herbalists was the sweet-brier, *Rosa rubiginosa*, but the name is more properly applied to *Rosa Eglanteria*. The sweet-brier has become extensively naturalized in eastern North America, growing abundantly in pastures, thickets and road-sides from Nova Scotia and Ontario south-westward to Tennessee and Kansas. Eglantine is frequently alluded to in the writings of English poets, from Chaucer downwards. Milton, in *L'Allegro*, is thought by the term "twisted eglantine" to denote the honeysuckle, *Lonicera Periclymenum*, which is still known as eglantine in north-east Yorkshire.

EGLINTON, EARLS OF. The title of earl of Eglinton has been held by the famous Scottish family of Montgomerie since 1506. The attempts made to trace the descent of this house to Roger of Montgomery, earl of Shrewsbury (d. 1094), one of William the Conqueror's followers, will not bear examination, and the sure pedigree of the family only begins with Sir John Montgomerie, lord of Eaglesham, who fought at the battle of Otterbourne in 1388 and died about 1398. His grandson, Sir Alexander Montgomerie (d. *c.* 1460), was made a lord of the Scottish parliament about 1445 as Lord Montgomerie, and Sir Alexander's great-grandson Hugh, the 3rd lord (*c.* 1460–1545), was created earl of Eglinton, or Eglintoun, in 1508. Hugh, who was a person of importance during the minority of James V., was succeeded by his grandson Hugh (d. 1546), and then by the latter's son Hugh (*c.* 1531–1585), who became 3rd earl of Eglinton. The 3rd earl

was a firm supporter of Mary queen of Scots for whom he fought at Langside and of the Roman Catholic Church his son and successor Hugh was murdered in April 1586 by the Cunninghames a family with which his own had an hereditary blood feud. In 1612, by the death of Hugh, the 5th earl, the male line of the Montgomeries became extinct.

The most famous of the earls of Eglinton are the 6th earl, commonly called "Greysteel," a prominent covenanter who fought against Charles I. at Marston Moor, and the 13th earl, Archibald William, who is remembered for the tournament which took place at Eglinton Castle, described by Disraeli in *Endymion*. He became lord-lieutenant of Ireland in 1852 under the Derby ministry and again in 1858–59.

See Sir W. Fraser, *Memorials of the Montgomeries, earls of Eglinton* (1859).

EGMONT, EARLS OF. JOHN PERCEVAL, 1ST EARL OF EGMONT (1683–1748), Irish politician, and partner with J. E. Oglethorpe in founding the American colony of Georgia, was created earl in 1733. He claimed descent from the Egmonts of Flanders, but his title was taken from the place in County Cork where the family residence stood. The first earl of Egmont (who had been made Baron Perceval in 1715, and Viscount Perceval in 1723) is chiefly important for his connection with the colonization of Georgia, and for his voluminous letters and writings on biography and genealogy.

JOHN PERCEVAL, 2ND EARL OF EGMONT (1711–1770), his eldest son, was first lord of the admiralty (1763–66). One of his younger sons was SPENCER PERCEVAL, prime minister of England.

EGMONT (EGMOND), **LAMORAL,** COUNT OF, prince of Gavre (1522–1568), was born in Hainaut in 1522. He was the younger of the two sons of John IV., count of Egmont, by his wife Françoise of Luxemburg, princess of Gavre. On the death of his elder brother Charles, about 1541, he succeeded to his titles and estates. He served in the expedition (1541) of the emperor Charles V. to Algiers. In 1544 he married Sabina, sister of the elector palatine Frederick III. Created knight of the Golden Fleece in 1546, he accompanied Philip of Spain in his tour through the Netherland towns, and in 1554 he was sent to England to ask the hand of Mary of England for Philip; he was present at the wedding ceremony at Winchester. In the summer of 1557 Egmont was appointed commander of the Flemish cavalry in the war between Spain and France, and the victory of St. Quentin was determined by the brilliant charge which he led against the French. In 1558 he encountered the French army under de Thermes at Gravelines, on its march homewards after the invasion of Flanders, totally defeated it, and took Marshal de Thermes prisoner. The battle was fought against the advice of the duke of Alva, and the victory made Alva Egmont's enemy. But the count now became the idol of his countrymen, who looked upon him as the saviour of Flanders from the devastations of the French. He was nominated by Philip stadtholder of Flanders and Artois. At the conclusion of the war by the Treaty of Cateau-Cambrésis, Egmont was one of the four hostages selected by the king of France as pledges for its execution.

The attempt made by King Philip to convert the Netherlands into a Spanish dependency and to govern it by Spanish ministers excited the resentment of Egmont and other leading members of the Netherlands aristocracy (*see* NETHERLANDS: *History*). As a member of the council of state Egmont joined the prince of Orange in a vigorous protest addressed to Philip (1561) against Granvella's administration; and two years later he again protested in conjunction with the prince of Orange and Count Horn. In the spring of 1564 Granvella left the Netherlands, and the malcontent nobles once more took their places in the council of state. But Philip's determination to enforce the decrees of the council of Trent throughout the Netherlands once more aroused their resentment; and, in Jan. 1565, Egmont went on a special mission to Spain to inform Philip of the state of affairs. At Madrid the king steadily evaded any serious discussion of the object of his mission, and Egmont finally returned home without having accomplished anything. At the same time Philip sent further instructions to the regent to abate nothing of the severity of the persecution.

In 1566 a confederacy of the lesser nobility was formed (*Les Gueux* whose principles were set out in a document known as the Compromise. From this league Egmont held aloof; he declined to take any step savouring of actual disloyalty to his sovereign. He withdrew to his government of Flanders, and as stadtholder took active measures for the persecution of heretics. But in the eyes of Philip he had long been a marked man. In the summer of 1567 the duke of Alva was despatched to the Netherlands at the head of an army of veterans to supersede the regent Margaret and restore order in the discontented provinces. Orange fled to Germany after having vainly warned Egmont and Horn of the dangers that threatened them. Alva was at pains to lull their suspicions, and then suddenly seized them both and threw them in the castle of Ghent. Their trial was a farce, for their fate had already been determined before Alva left Spain. After some months of imprisonment they were removed to Brussels, where sentence was pronounced upon them (June 4) by the infamous Council of Blood erected by Alva. They were condemned to death for high treason. Egmont was beheaded at Brussels in the square before the town hall, on the day after his sentence had been publicly pronounced (June 5, 1568). He met his fate with calm resignation; and in the storm of terror and exasperation to which this tragedy gave rise Egmont's failings were forgotten, and he and his fellow-victim to Spanish tyranny were glorified in the popular imagination as martyrs of Flemish freedom. From this memorable event, which Goethe made the theme of his play *Egmont* (1788), is usually dated the beginning of the famous revolt of the Netherlands. In 1865 a monument to Counts Egmont and Horn, by Fraiken, was erected on the spot where they were beheaded.

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EGO (Latin for I), the Self, in contrast with Alter (Lat. for other), another person, or NON-EGO, anything other than the self. Different views have been put forward as to the development of the consciousness of the self and of other selves. According to some, each of us has an immediate intuition both of his own self and of other selves. Others maintain that we each begin with an apprehension of his own self, and only arrive at an apprehension of other selves by a process of projection or "ejection" of our own self into other bodies, so to say. Others, again, hold that we get to know other selves and then discover each his own self by a process of interpretation based on our knowledge of others. The prevailing view among psychologists is that the two processes of knowing one's own self and of knowing other selves go on simultaneously, and that our knowledge of each is made richer by contrast with the other.

EGOISM, a modern philosophical term used generally, in opposition to "Altruism," for any ethical system in which the happiness or the good of the individual is the main criterion of moral action (from Gr. and Lat. *ego*, I, the 1st personal pronoun). Another form of the word, "Egotism," is really interchangeable, though in ordinary language it is often used specially (and similarly "egoism," as in George Meredith's *Egoist*) to describe the habit of magnifying one's self and one's achievements, or regarding all things from a selfish point of view. Both these ideas derive from the original meaning of *ego*, myself, as opposed to everything which is outside myself. This antithesis of ego and non-ego, self and not-self, may be understood in several senses according to the connection in which it is used. Thus the self may be held to include one's family, property, business and an indefinitely wider range of persons or objects in which the individual's interest is for the moment centred, *i.e.*, everything which I can call "mine." In this, its widest sense "a man's Self is the sum total of all that he *can* call his" (Wm. James, *Principles of Psychology*, ch. x.). This self may be divided up in many ways according to the various forms in which it may be expressed. Thus James (*ibid.*) classifies the various "selves" as the material, the spiritual, the social and the "pure." Or again the self may be narrowed

...ed to a man's own person, consisting of an individual mind and body. In the true philosophic sense, however, the conception of the ego is still further narrowed down to the individual consciousness as opposed to all that is outside it, *i.e.*, can be its object. This conception of the self belongs mainly to metaphysics and involves the whole problem of the relation between subject and object, the nature of reality and the possibility of knowledge of self and of object. The ordinary idea of the self as a physical entity absolutely separate from others takes no account of the problems as to how and in what sense the individual is conscious of himself, what is the relation between subject and object in the phenomenon of self-consciousness in which the mind reflects upon itself both past and present? The mind is in this case both subject and object, or as William James puts it, both "I" and "me." The phenomenon has been described in various ways by different thinkers. Thus Kant distinguished the two selves as rational and empirical, just as he distinguished the two egos as the noumenal or real and the phenomenal from the metaphysical standpoint. A similar distinction is made by Herbart. Others have held that the self has a complex content, the subject self being, as it were, a fuller expression of the object-self (so Bradley); or again the subject self is the active content of the mind and the object self the passive content which for the moment is exciting the attention. The most satisfactory and also the most general view is that consciousness is complex and unanalysable.

The relation of the self to the not-self need not to be treated here (*see* METAPHYSICS). It may, however, be pointed out that in so far as an object is cognized by the mind, it becomes in a sense part of the complex self-content. In this sense the individual is in himself his own universe, his whole existence being, in other words, the sum total of his psychic relations, and nothing else being *for him* in existence at all. A similar idea is prominent in many philosophico-religious systems wherein the idea of God or the Infinite is, as it were, the union of the ego and the non-ego, or subject and object. The self of man is regarded as having limitations, whereas the Godhead is infinite and all-inclusive. In many mystical oriental religions the perfection of the human self is absorption in the infinite, as a ripple dies away on the surface of water. The problems of the self may be summed up as follows. The psychologist investigates the ideal construction of the self, *i.e.*, the way in which the conception of the self arises, the different aspects or contents of the self and the relation of the subject to the object self. At this point the epistemologist takes up the question of empirical knowledge and considers the kind of validity, if any, which it can possess. What existence has the known object for the knowing subject? The result of this enquiry is generally intellectual scepticism in a greater or less degree, namely, that the object has no existence for the knower except a relative one, *i.e.*, in so far as it is "known." Finally the metaphysician, and in another sphere the theologian, consider the nature of the pure or transcendental self apart from its relations, *i.e.*, the absolute self.

In ethics, egoistic doctrines disregard the ultimate problems of selfhood, and assume the self to consist of a man's person and those things in which he is or ought to be directly interested. The general statement that such doctrines refer all moral action to criteria of the individual's happiness, preservation, moral perfection, raises an obvious difficulty. Egoism merely asserts that the self is all-important in the application of moral principles, and does not in any way supply the material of these principles. It is a purely formal direction, and as such merely an adjunct to a substantive ethical criterion. A practical theory of ethics seeks to establish a particular moral ideal; if it is an absolute criterion, then the altruist would place first the attainment of that ideal by others, while the egoist would seek it for himself. The same is true of ethical theories which may be described as material. Of the second type are those, *e.g.*, of Hobbes and Spinoza, which advocate self-preservation as the ideal, as contrasted with modern evolutionist moralists who advocate race-preservation. Again, we may contrast the early Greek hedonists, who bade each man seek the greatest happiness (of whatever kind), with modern utilitarian and social hedonists, who prefer the greatest good or the greatest happiness of the greatest number. It is with hedonistic and other empirical theories that egoism is generally associated. As a matter of fact, however, egoism has been no less prominent in intuitional ethics. Thus the man who seeks only or primarily his own moral perfection is an egoist par excellence. Such are ascetics, hermits and the like, whose whole object is the realization of their highest selves.

The distinction of egoistical and altruistic action is further complicated by two facts. In the first place, many systems combine the two. Thus Christian ethics may be said to insist equally on duty to self and duty to others, while crudely egoistic systems become unworkable if a man renders himself obnoxious to his fellows. On the other hand, every deliberate action based on an avowedly altruistic principle necessarily has a reference to the agent; if it is right that A should do a certain action for the benefit of B, then it tends to the moral self-realization of A that he should do it. Upon whatsoever principle the rightness of an action depends, its performance is right *for the agent*. The self-reference is inevitable in every action in so far as it is regarded as voluntary and chosen as being of a particular moral quality.

It is this latter fact which has led many students of human character to state that men do in fact aim at the gratification of their personal desires and impulses. The laws of the State and the various rules of conduct laid down by religion or morality are merely devices adopted for general convenience. The most remarkable statement of this point of view is that of Friedrich Nietzsche, who went so far as to denounce all forms of self-denial as cowardice:—let every one who is strong seek to make himself dominant at the expense of the weak.

EGORIEVSK, a town in the Moscow province of the Russian S.F.S.R., connected by a branch line with the Moscow to Ryazan railway. Lat. 55° 23′ N., long. 38° 57′ E. Pop. (1926) 27,991. Its manufactures include dyes and dyed fabrics, cotton goods, ready made garments and buttons. There is a municipal electric plant.

EGREMONT, EARLS OF. In 1749 Algernon Seymour 7th duke of Somerset, was created earl of Egremont, and on his death without heirs in Feb. 1750 this title passed by special remainder to his nephew, Sir Charles Wyndham or Windham Bart. (1710–1763), a son of Sir William Wyndham of Orchard Wyndham, Somerset. Charles was a member of parliament from 1734 to 1750, and in Oct. 1761 he was appointed secretary of State for the southern department in succession to William Pitt. His term of office, during which he acted in concert with his brother-in-law, George Grenville, was mainly occupied with the declaration of war on Spain and with the negotiations for peace with France and Spain, a peace the terms of which the earl seems to have disliked.

The 2nd earl's son and successor, GEORGE O'BRIEN WYNDHAM (1751–1837), was more famous as a patron of art and an agriculturist than as a politician. For some time the painter Turner lived at his Sussex residence, Petworth House, and in addition to Turner, the painter Leslie, the sculptor Flaxman and other talented artists received commissions from Egremont, who filled his house with valuable works of art. Generous and hospitable, blunt and eccentric, the earl was in his day a very prominent figure in English society. On the death of his nephew and successor George Francis Wyndham, the 4th earl (1785–1845), the earldom of Egremont became extinct. Petworth, however, and the large estates had already passed to George Wyndham (1787–1869), a natural son of the 3rd earl, who was created Baron Leconfield in 1859.

EGREMONT, market town, urban district, Whitehaven parliamentary division, Cumberland, England, 5 m S.E. of Whitehaven on the L.M.S. railway. Pop. (1921) 6,582. It is pleasantly situated in the valley of the Ehen. Ruins of a castle command the town. It was founded *c.* 1120 by William de Meschines; it is moated, and retains a Norman doorway and some of the original masonry, as well as fragments of later date. In the church of St Mary, modern reconstruction embodies some of the Norman features of the old church. Iron ore and limestone are raised in the neighbourhood. Henry I. gave the barony of Coupland o

William de Meschines, who erected a castle at Egremont around which the town grew. The barony passed to the families of Lucy and Multon, and finally to the Percys, earls of Northumberland, from whom are descended the present lords of the manor of Egremont. In a charter in the reign of King John, the town is called a borough. The borough was represented by two members in the parliament of 1295, but in the following year was disfranchised. In 1267 Henry III. granted a market every Wednesday and a fair every year on the eve, day and morrow of the Nativity of the Virgin Mary. There was also another weekly market on Saturday. The market rights were purchased from Lord Leconfield in 1885, and the market on Saturday is still held. Richard de Lucy's charter shows that dyeing, weaving and fulling were carried on in the town in his time.

EGRESS, in astronomy, the end of the apparent transit of a small body over the disk of a larger one; especially of a transit of a satellite of Jupiter over the disk of that planet. It designates the moment at which the smaller body is seen to leave the limb of the other.

EGRET, the name given to those birds of genus *Egretta,* which are characterized by a white plumage, and, in the breeding season, by long dorsal plumes, from which the barbules are absent, thus giving them a silky appearance. They are known to the feather trade as "ospreys" and are highly valued as ornaments. The largest form is *E. occidentalis* from Florida and Cuba, about 4ft long. The European *E. alba* is slightly smaller. The American egret, *E. egretta,* measures about three feet. The snowy egret, *E candidissima,* is smaller. Other species occur in Asia and Australia. In certain parts of the world (*e.g.,* southern U.S.A.) egrets were in danger of becoming scarce or extinct owing to the depredations of the plume-hunters. But protection by the Audubon Societies and legislation on the importation of plumage are now bringing about a revival in numbers in some places. The American egret wanders northward in summer, often visiting the north Atlantic states.

EGYPT, a country forming the north-eastern extremity of Africa. It is bounded north by the Mediterranean, south by the Anglo-Egyptian Sudan, north-east by Palestine, east by the Red sea, west by Tripoli and the Sahara. The western frontier starts from the Gulf of Sollum in the Mediterranean, runs in a slightly south-westerly direction, leaving the oasis of Jarabub in Tripoli and the oasis of Siwa in Egypt, until it reaches the 25th meridian, and then follows it south to the 22nd parallel, which forms throughout the boundary between Egypt and the Sudan. The north-east frontier is an almost direct line drawn from Taba, near the head of the Gulf of Akaba, the eastern of the two gulfs into which the Red sea divides, to the Mediterranean at Rafa in 34° 15′ E. The peninsula of Sinai, geographically part of Asia, is thus included in the Egyptian dominions. The total area of the country is about 386,000 sq.m., or more than three times the size of the British Isles. Of this area $\frac{4}{5}$ is desert. Canals, roads, date plantations, etc., cover 1,900 sq.m.; 2,850 sq.m. are comprised in the surface of the Nile, marshes, lakes, etc ; and the cultivable area is about 12,000 sq. miles. A line drawn just south of Cairo, divides the country into Lower and Upper Egypt, or the Delta and the Nile valley. By the Arabs Lower Egypt is called Er-Rif, the cultivated or fertile; Upper Egypt Es Sa'id, the happy or fortunate. Another division of the country is into Lower, Middle and Upper Egypt, Middle Egypt in this classification being the district between Cairo and Assiut.

General Character.—The distinguishing features of Egypt are the Nile and the desert. But for the river there would be nothing to differentiate the country from other parts of the Sahara. The Nile, however, piercing the desert, and at its annual overflow depositing rich sediment brought from the Abyssinian highlands, has created the Delta and the fertile strip in Upper Egypt. Beyond the Nile valley east and west stretch great deserts, containing here and there fertile oases. The Delta is a level plain, richly cultivated, and varied alone by the lofty dark-brown mounds of ancient cities, and the villages set in groves of palm-trees, standing on mounds often, if not always, ancient. In Upper Egypt the Nile valley is very narrow and is bounded by mountains of no great height. They form the edge of the desert on either side of the valley, of which the bottom is level rock. The bright green of the fields, the reddish-brown or dull green of the great river, contrasting with the bare yellow rocks, seen beneath a brilliant sun and a deep-blue sky, present views of great beauty. In form the landscape varies little and is not remarkable; in colour its qualities are always splendid, and under a general uniformity show a continual variety.

GEOGRAPHICAL FEATURES

Egypt has a coast-line which extends to over 600 m. on the Mediterranean and to about 1,200 m. on the Red sea. The Mediterranean coast extends from the Gulf of Sollum on the west to Rafa on the east. From the gulf to the beginning of the Delta the coast possesses no good harbourage, and is fringed by the cliffs of a stony plateau, which southward joins the more arid and uninhabitable wastes of the Libyan desert. The Delta coast-line composed of sandhills and, occasionally, limestone rocks, is low, with cape-like projections at the Nile mouths formed by the river silt. Beyond the Delta eastward the coast is again barren and without harbours. It rises gradually southward, merging into the plateau of the Sinai peninsula. The Red sea coast is everywhere mountainous, in continuation of the Abyssinian tableland, and some of the peaks are over 6,000 ft. above the sea.

The Nile Valley (*see* also NILE). Entering Egypt proper, a little north of the Second Cataract, the Nile flows through a valley in sandstone beds as far as 25° N., and throughout this part of its course the valley is extremely narrow, rarely exceeding 2 m. in width. At two points, namely, Kalabsha—the valley here being only 170 yd. wide and the river over 100 ft. deep—and Aswan (First Cataract), the course of the river is interrupted by outcrops of granites and other crystalline rocks, forming the mass of islands, with numerous small rapids, which are described not very accurately as cataracts. From 25° N. northwards for 518 m. the valley is of the "rift-valley" type, a level depression in a limestone plateau, enclosed usually by steep cliffs, which rise to 1,800 ft. between Esna and Kena. The average width of the cultivated land is about 10 m., of which the greater part lies on the left bank of the river; and outside this is a belt, varying from a few hundred yards to 3 or 4 m. of stony and sandy ground, reaching up to the foot of the limestone scarp. This continues as far as 29° N., after which the hills that close in the valley become lower, and the higher plateaus lie at a distance of 10 or 15 m. back in the desert. West of the Nile, and separated from it by a narrow strip of desert, between the 29th and 30th parallels, lies the Fayum. It contains the Sweetwater lake, the Birket-el-Kurun, about 140 ft. below sea-level, and is fertilized by an old branch of the Nile, the Bahr-Yusuf, which has been canalized and enters the Fayum through a gap in the desert hills by the 12th dynasty pyramids of Lahun and Hawara.

The Delta.—About 30° N., where the city of Cairo stands, the hills which have hitherto run parallel with the Nile turn outwards, and the triangular area between them is wholly deltaic. The Delta is a wide alluvial plain sloping gently towards the sea, measuring 100 m. from south to north and resting on 155 m. of sea-front from Alexandria to Port Said. The Nile alluvium, containing alumina (about 48%) and calcium carbonate (18%) is believed to increase at the rate of 4½ in. in a century; so fine are its particles that at places it becomes almost a stiff clay. It ranges in thickness from 55 to 70 ft., and underneath it lies a series of yellow quartz sands, intermixed with pebbles, gravel and clay, the rocky base of which has not yet been disclosed by borings. The surface of the Delta is the most fertile part of Egypt, and is irrigated by the Damietta and Rosetta arms of the Nile, as well as by a network of canals. On the sea face it degenerates into a shore of low sand-hills, with a line of lagoons and salt marshes behind them.

The Lakes.—The lagoons or lakes of the Delta, going from west to east, are Mareotis (Mariut), Edku, Burlus and Menzala. The land separating them from the Mediterranean is nowhere more than 10 m., and in some places only a few hundred yards wide. All the lakes are shallow and the water in them salt or brack

[illegible] expanse of marsh, when at its highest the [illegible] about 100 sq. miles. In ancient times the lake was the [illegible] country, famous for its wine. Later it shrank in size, and villages sprang up on its dry bed. In April 1801 the British army besieging Alexandria cut through the land between [illegible] and the lake, admitting the waters of the sea and laying under water the large area then in cultivation. This proceeding was twice imitated, first by the Turks in 1803 and a second time by the British in 1807. Mareotis has no outlet, and the water is kept at a uniform level by means of powerful pumps which neutralize the effect of the Nile flood. A western arm has been cut off from the lake by a dyke, and in this arm a thick crust of salt is formed each year after the evaporation of the flood water. East of Maryut and reaching to within 4 m. of the Rosetta branch of the Nile, lies Edku, 22 m. long and in places 16 wide, with an opening supposed to be the ancient Canopic mouth of the Nile, into Aboukir bay. Burlus begins a little eastward of the Rosetta channel, and stretches bow-shaped for 64 miles. Its greatest width is about 16 m., and through it ran the ancient Sebennytic branch of the Nile. Burlus is noted for its water-melons, which are yellow within and come into season after those grown on the banks of the Nile.

Menzala greatly exceeds the other Delta lakes in size, covering over 750 sq. miles. It extends from very near the Damietta branch of the Nile to Port Said, and receives the waters of the canalized channels which were once the Tanitic, Mendesian and Pelusiac branches. The northern shore is separated from the sea by an extremely narrow strip of land, and the Suez canal runs along its eastern edge. It contains a large number of islands, one of which, Tennis (anciently Tennesus), contains ruins of the Roman period. The lake supports a considerable population of fishermen, who dwell in villages on the shore and islands and live upon the fish of the lake. The reeds are cover for waterfowl of various kinds, which the traveller sees in great numbers, and wild boars are found in the marshes to the south. East of Menzala is the site of Serbonis, another dried-up lake, which had the general characteristics of the Delta lagoons. In the Isthmus of Suez are Lake Timsa and the Great and Little Bitter lakes, occupying part of the ancient bed of the Red sea. All three were dry or marshy depressions until the cutting of the Suez canal let the waters of the Mediterranean and Red sea into them (*see* SUEZ CANAL).

A chain of natron lakes (seven in number) lies in a valley in the western desert, 70 to 90 m. W.N.W. of Cairo. In the Fayum province farther south is the Birket-el-Kurun, some 30 m. long and 5 wide at its broadest part, being all that now represents the storied Lake of Moeris. Near the lake are several sites of ancient towns, and the temple called Kasr-Karun, dating from Roman times, distinguishes the most important of these.

The Desert Plateaux.—From the southern borders of Egypt to the Delta in the north, the desert plateaux extend on either side of the Nile valley. The eastern region, between the Nile and the Red sea, varies in width from 90 to 350 m. and is known in its northern part as the Arabian desert. The western region has no natural barrier for many hundreds of miles; it is part of the vast Sahara. North of Aswan it is called the Libyan desert. In the north the desert plateaux are comparatively low, but from Cairo southwards they rise to 1,000 and even 1,500 ft. above sea-level. The weathering of this desert area is probably fairly rapid, the agents at work being principally the rapid heating and cooling of the rocks by day and night, and the erosive action of sand-laden wind on the softer layers; these, aided by the occasional rain, are ceaselessly at work, and produce the successive plateaux, dotted with small isolated hills and cut up by valleys (wadis) which occasionally become deep ravines, thus forming the principal type of scenery of these deserts. East of the Nile the desert meets the line of mountains which runs parallel to the Red sea and the Gulf of Suez. In the western desert, however, those large sand accumulations which are usually associated with a desert are met with. They occur as long, narrow lines of dunes formed of [illegible] of quartz [illegible] in the direction of the prevalent [illegible] places they cover immense areas, rendering them absolutely impassable except in a direction parallel to the lines themselves. East of the oases of Baharia and Farafra is a very striking line of these sand dunes: rarely more than 3 m. wide, it extends for a length of nearly 350 miles.

Oases.—In the western desert lie the five large oases of Egypt, namely, Siwa, Baharia, Farafra, Dakhla and Kharga or Great oasis, occupying depressions in the plateau or, in the case of the last three, large indentations in the face of limestone escarpments which form the western versant of the Nile valley hills. Their fertility is due to a plentiful supply of water furnished by a sandstone bed 300 to 500 ft. below the surface, whence the water rises through natural fissures or artificial boreholes. These oases were known and occupied by the Egyptians as early as 1600 B.C., and Kharga rose to special importance at the time of the Persian occupation. Here, near the town of Kharga, the ancient Hebi, is a temple of Ammon built by Darius I., and in the same oasis are other ruins of the period of the Ptolemies and Caesars. The oasis of Siwa (Jupiter Ammon) is about 150 m. S. of the Mediterranean at the Gulf of Sollum and about 300 m. W. of the Nile. The other four oases lie parallel to and distant 100 to 150 m. from the Nile, between 25° and 29° N., Baharia being the most northerly and Kharga the most southerly.

Besides the oases the desert is remarkable for two other valleys. The first is that of the natron lakes already mentioned. It contains four monasteries, the remains of the famous anchorite settlement of Nitriae. South of the Wadi Natron, and parallel to it, is a sterile valley called the Bahr-bela-Ma, or "River without Water."

The Sinai Peninsula.—The triangular-shaped Sinai peninsula has its base on the Mediterranean, the northern part being an arid plateau, the desert of Tih. The apex is occupied by a massif of crystalline rocks, which rise bare and steep (in places to a height of over 8,500 ft.) from the valleys and support hardly any vegetation. In some of the valleys wells or rock-pools filled by rain occur, and furnish drinking-water to the few Arabs who wander in these hills.

CLIMATE AND GEOLOGY

Geology.—The oldest formation in the eastern part of the country is a great tract of uneven crystalline schists, which runs from the Sinai peninsula to the north border of Abyssinia. Overlying the crystalline rock in this area is a thick volcanic series, in which are numerous intrusions of granite, which furnished the chief material for the ancient monuments. At Aswan (Syene) the well-known syenite of Werner occurs. It is, however, a hornblende granite and does not possess the mineralogical composition of the syenites of modern petrology. On the western side of the country, from Thebes to Khartoum, the crystalline formation is overlaid by Nubian sandstone, which extends westward from the river to the edge of the great Libyan desert, where it forms the bed rock. Above the sandstone in many places lie a series of clays: and over them in turn rests the thick layer of soft white limestone which lines the Nile valley south of Cairo and furnishes fine building stone. In the Kharga oasis the upper portion consists of variously coloured unfossiliferous clays with intercalated bands of sandstone containing fossil silicified woods (*Nicolia Aegyptiaca* and *Araucarioxylon Aegypticum*). They are conformably overlain by clays and limestones with *Exogyra Overwegi* belonging to the Lower Danian, and these by clays and white chalk with *Ananchytes ovata* of the Upper Danian. The fluvio-marine deposits of the Upper Eocene and Oligocene formations contain an interesting mammalian fauna: *Arsinoitherium* is the precursor of the horned Ungulata; while *Moeritherium* and *Palaeo-mastodon* undoubtedly include the oldest known elephants. Miocene strata are absent in the southern Tertiary areas, but are present at Moghara and in the North. Marine Pliocene strata occur to the south of the pyramids of Giza and in the Fayum province, where, in addition some gravel terraces at a height of 500 ft. above sea level are attributed to the Pl[illegible] period. The Lake of Moeris as a large body of fresh water

appear to have come into existence in Pleistocene times. It is represented now by the brackish water lake of the Birket-el-Kurun. The superficial sands of the deserts and the Nile mud form the chief recent formations. The Nile deposits its mud over the valley before reaching the sea, and consequently the Delta receives little additional material. The superficial sands of the desert region, derived in large part from the disintegration of the Nubian sandstone, occupy the most extensive areas in the Libyan desert. The other desert regions of Egypt are elevated stony plateaux, which are diversified by extensively excavated valleys and oases. These regions present magnificent examples of dry erosion by wind-borne sand, which acts as a powerful sand blast etching away the rocks and producing most beautiful sculpturing. The rate of denudation in exposed positions is exceedingly rapid; while spots sheltered from the sand blast suffer a minimum of erosion, as shown by the preservation of ancient inscriptions. Many of the Egyptian rocks in the desert areas and at the cataracts are coated with a highly polished film, of almost microscopic thinness, consisting chiefly of oxides of iron and manganese with salts of magnesia and lime. It is supposed to be due to a chemical change within the rock and not to deposition on the surface.

Minerals.—Egypt possesses considerable mineral wealth. In ancient times gold and precious stones were mined in the Red sea hills. Efforts were made to re-establish the industry at the beginning of this century, but they have not been encouraging. Manganese, however, has been mined in increasing quantities during the last ten years, and its output in 1926 rose to over 120,000 metric tons. Another new industry is petroleum, for which prospecting is active: but the production of 1926 was only 173,000 tons. The salt obtained from Lake Mareotis supplies the salt needed for the country, except a small quantity used for curing fish at Lake Menzala; while the lakes in the Wadi Natron, 45 m. N.W. of the pyramids of Giza, furnish carbonate of soda in large quantities. Alum is found in the western oases. Nitrates and phosphates are also found in various parts of the desert and are used as manures. The turquoise mines of Sinai, in the Wadi Maghara, are worked regularly by the Arabs of the peninsula, who sell the stones in Suez; while there are emerald mines at Jebel Zubara, south of Kosseir. Considerable veins of haematite of good quality occur both in the Red sea hills and in Sinai. At Jebel ed-Dukhan are porphyry quarries, extensively worked under the Romans, and at Jebel el-Fatira are granite quarries. At El-Hammamat, on the old way from Coptos to Philoteras Portus, are the breccia verde quarries, worked from very early times, and having interesting hieroglyphic inscriptions. The quarries of Syene (Aswan) are famous for extremely hard and durable red granite (syenite), and have been worked since the days of the earliest Pharaohs. Large quantities of this syenite were used in building the Aswan dam (1898–1902). The cliffs bordering the Nile are largely quarried for limestone and sandstone.

Climate.—Part of Upper Egypt is within the tropics, but the greater part of the country is north of the Tropic of Cancer. Except a narrow belt along the Mediterranean shore, Egypt lies in an almost rainless area, where the temperature is high by day and sinks quickly at night in consequence of the rapid radiation under the cloudless sky. The mean temperature at Alexandria and Port Said varies between 57° F in January and 81° F in July; while at Cairo, where the proximity of the desert begins to be felt, it is 53° F in January, rising to 84° F in July. January is the coldest month, when occasionally in the Nile valley, and more frequently in the open desert, the temperature sinks to 32° F, or even a degree or two below. The mean maximum temperatures are 99° F for Alexandria and 110° F for Cairo. Farther south the range of temperature becomes greater as pure desert conditions are reached. Thus at Aswan the mean maximum is 118° F, the mean minimum 42° F.

The relative humidity varies greatly. At Aswan the mean value for the year is only 38%, that for the summer being 29%, and for the winter 51%; at Cairo the corresponding figures are about 45% and 70%. A white fog, dense and cold, sometimes rises from the Nile in the morning, but it is of short duration and rare occurrence. In Alexandria and on all the Mediterranean coast of Egypt rain falls abundantly in the winter months, from 8 to 12 in. in the year; but southwards it rapidly decreases, and south of 31° N. little rain falls.

Records at Cairo show that the rainfall is very irregular, and is furnished by occasional storms rather than by any regular rainy season: still, it is growing more frequent and approximates 2 in. in the year. In the open desert rain falls even more rarely, but it is by no means unknown, and from time to time heavy storms burst, causing sudden floods in the narrow ravines, and drowning both men and animals. Snow is unknown in the Nile valley, but on the mountains of Sinai and the Red sea hills it is not uncommon, and a temperature of 18° F at an altitude of 2,000 ft. has been recorded in January.

The atmospheric pressure, with a mean of just under 30 in., varies between a maximum in January and a minimum in July, the mean difference being about 0·29 in.

The most striking meteorological factor in Egypt is the persistence of the north wind throughout the year, without which the climate would be very trying. At Cairo, in the winter months, south and west winds are frequent; but after this the north blows almost continuously for the rest of the year. Farther south the southern winter winds decrease rapidly, becoming westerly, until at Aswan and Wadi Halfa the northerly winds are almost invariable throughout the year. The *khamsin*, hot sand-laden winds of the spring months, come invariably from the south. They are preceded by a rapid fall of the barometer for about a day, when the wind starts in a southerly quarter, and drops about sunset. The same thing is repeated on the second and sometimes the third day, by which time the wind has worked round to the north again. During a khamsin the temperature is high and the air extremely dry, while the dust and sand carried by the wind form a thick yellow fog obscuring the sun. Another remarkable phenomenon is the *zobaa*, a lofty whirlwind of sand resembling a pillar, which moves with great velocity.

One of the most interesting phenomena of Egypt is the mirage, which is frequently seen both in the desert and in the waste tracts of uncultivated land near the Mediterranean; and it is often so truthful in its appearance that one finds it difficult to admit the illusion.

FLORA AND FAUNA

Flora.—Egypt possesses neither forests nor woods and, as practically the whole of the country which will support vegetation is devoted to agriculture, the flora is limited. The most important tree is the date-palm, which grows all over Egypt and in the oases. The dom-palm is first seen a little north of 26° N., and extends southwards. The vine grows well, and in ancient times was largely cultivated for wine; oranges, lemons and pomegranates also abound. Mulberry trees are common in Lower Egypt. The sunt tree (*Acacia nilotica*) grows everywhere, as well as the tamarisk and the sycamore. In the deserts halfa grass and several kinds of thorn bushes grow; and wherever rain or springs have moistened the ground, numerous wildflowers thrive. This is especially the case where there is also shade to protect them from the midday sun, as in some of the narrow ravines in the eastern desert and in the palm groves of the oases, where various ferns and flowers grow luxuriantly round the springs. Among many trees which have been imported, the "lebbek" (*Albizzia lebbek*), a thick-foliaged mimosa, thrives especially, and has been very largely employed. The weeping-willow, myrtle, elm, cypress and eucalyptus are also used in the gardens and plantations.

The most common of the fruits are dates, of which there are nearly 30 varieties, which are sold half-ripe, ripe, dried, and pressed in their fresh moist state in mats or skins. The pressed dates of Siwa are among the most esteemed. The Fayum is celebrated for its grapes, and chiefly supplies the market of Cairo. The best-known fruits, besides dates and grapes, are figs, sycamore-figs and pomegranates, apricots and peaches, oranges and citrons, lemons and limes, bananas, different kinds of melons (including some of aromatic flavour, and the refreshing water-melon), mulberries, Indian figs or prickly pears, the fruit of the lotus and olives. Among the more usual cultivated flowers are the rose

[illegible] plant (Lawsonia alba), or Egyptian privet, the [illegible] and the violet. Of wild flowers the most common are yellow daisies, poppies, irises, asphodels and ranunculuses. The *Poinciana pulcherrima* is a bushy tree with leaves of brilliant red.

Many kinds of reeds are found in Egypt, though they were formerly much more common. The famous byblus or papyrus no longer exists in the country, but other kinds of *cyperi* are found. The lotus, greatly prized for its flowers by the ancient inhabitants, is still found in the Delta, though never in the Nile itself.

Fauna.—The chief quadrupeds are all domestic animals. Of these the camel and the ass are the most common. The ass, often a tall and handsome creature, is indigenous. When the camel was first introduced into Egypt is uncertain—it is not pictured on the ancient monuments. Neither is the buffalo, which with the sheep is very numerous in Egypt. The horses are of indifferent breed, apparently of a type much inferior to that possessed by the ancient Egyptians. Wild animals are few. The principal are the hyena, jackal and fox. The wild boar is found in the Delta. Wolves are rare. Numerous gazelles inhabit the deserts. The ibex is found in the Sinaitic peninsula and the hills between the Nile and the Red sea, and the moufflon, or maned sheep, is occasionally seen in the same regions. The desert hare is abundant in parts of the Fayum, and a wild cat, or lynx, frequents the marshy regions of the Delta. The ichneumon (Pharaoh's rat) is common and often tame; the coney and jerboa are found in the eastern mountains. Bats are very numerous. The crocodile is no longer found in Egypt, nor the hippopotamus, in ancient days a frequenter of the Nile. Among reptiles are several kinds of venomous snakes—the horned viper, the hooded snake and the echis. Lizards of many kinds are found, including the monitor. There are many varieties of beetle, including a number of species representing the scarabaeus of the ancients. Locusts are comparatively rare. The scorpion, whose sting is sometimes fatal, is common. There are many large and poisonous spiders and flies; fleas and mosquitoes abound. Fish are plentiful in the Nile, both scaled and without scales. The scaly fish include members of the carp and perch kind, and over 100 species have been classified.

Some 300 species of birds are found in Egypt, and one of the most striking features of a journey up the Nile is the abundance of bird life. Birds of prey are very numerous, including several varieties of eagles—the osprey, the spotted, the golden and the imperial. Of vultures the black and white Egyptian variety (*Neophron percnopterus*) is most common. The griffon and the black vulture are also frequently seen. There are many kinds of kites, falcons and hawks, kestrel being numerous. The long-legged buzzard is found throughout Egypt, as are owls. The so-called Egyptian eagle owl (*Bubo ascalaphus*) is rather rare, but the barn owl is common. The kingfisher is found beside every water-course, a black and white species (*Ceryle rudis*) being much more numerous than the common kingfisher. Pigeons and hoopoes abound in every village. There are various kinds of plovers—the black-headed species (*Pluvianus aegyptius*) is most numerous in Upper Egypt; the golden plover and the white-tailed species are found chiefly in the Delta. The spurwing is supposed to be the bird mentioned by Herodotus as eating the parasites covering the inside of the mouth of the crocodile. Of game-birds the most plentiful are sandgrouse, quail (a bird of passage) and snipe. Red-legged and other partridges are found in the eastern desert and the Sinai hills. Of aquatic birds there is a great variety. Three species of pelican exist, including the large Dalmatian pelican. Storks, cranes, herons and spoonbills are common. The sacred ibis is not found in Egypt, but the buff-backed heron, the constant companion of the buffalo, is usually called an ibis. The glossy ibis is occasionally seen. The flamingo, common in the lakes of Lower Egypt, is not found on the Nile. Geese, duck and teal are abundant. The most common goose is the white-fronted variety; the Egyptian goose is more rare. Several birds of gorgeous plumage come north into Egypt in spring, such as the golden oriole, the sun-bird, the roller and the blue-cheeked bee-eater.

POPULATION

Few countries have suffered more, reckoned in terms of human life, from misgovernment, and few countries have recovered more promptly under humane administration, than Egypt. In 1800 the French estimated the population at no more than 2,460,000. At the beginning of British occupation (census of 1882) it was 6,813,919. In 1917, after 35 years of the British connection, the figure had risen to 12,750,918; and the census held in 1927 put it at 14,168,756. The result is a wholly abnormal density of population on the soil: if the desert regions be excluded, it is over 1,000 per sq.m., far in excess of Belgium or of Bengal.

Of the total population, about 20% is urban. In addition to pure nomads, there are half-a-million Bedouins described as "semi-sedentaries," *i.e.*, tent-dwelling Arabs, usually encamped in those parts of the desert adjoining the cultivated land. The rural classes are mainly engaged in agriculture, which occupies over 62% of the adults. The professional and trading classes form about 10% of the whole population, but 50% of the foreigners are engaged in trade.

Chief Towns.—*Cairo*, the capital and the largest city in Africa, stands on the Nile, at the head of the Delta, and has been called by the Arabs "the diamond stud in the handle of the fan of Egypt." Next in importance of the cities of Egypt and the chief seaport is Alexandria, on the shore of the Mediterranean at the western end of the Delta. Port Said, at the eastern end of the Delta, and at the north entrance to the Suez canal, is the second seaport. Between Alexandria and Port Said are the towns of Rosetta and Damietta, each built a few miles above the mouth of the branch of the Nile of the same name. The other ports of Egypt are Suez at the south entrance of the canal, Kosseir on the Red sea, the seat of the trade carried on between Upper Egypt and Arabia, Mersa Matruh, near the Tripolitan frontier, and El-Arish, on the Mediterranean, near the frontier of Palestine, and a halting-place on the caravan route from Egypt to Syria. In the interior of the Delta are many flourishing towns, the largest being Tanta, Damanhur, Mansura, Zagazig and Belbes. Ismailia is situated midway on the Suez canal. All these towns, which depend largely on the cotton industry, are separately noticed.

Other towns in Lower Egypt are, Mehallet el-Kubra, with manufactories of silk and cottons; Salihia on the edge of the desert south of Lake Menzala, and the starting-point of the caravans to Syria; Mataria on Lake Menzala and headquarters of the fishing industry; Zifta on the Damietta branch and the site of a barrage; Samanud, also on the Damietta branch, noted for its pottery, and Fua where large quantities of tarbushes are made, on the Rosetta branch. Shibin el-Kom is a cotton centre, and Menuf in the fork between the branches of the Nile, is the chief town of a rich agricultural district. There are many other towns in the Delta with populations between 10,000 and 20,000.

In Upper Egypt the chief towns are nearly all in the narrow valley of the Nile, except Medinet-el-Fayum, the capital of that oasis, with a pop. of 40,000. The chief towns on the Nile, taking them in their order in ascending the river from Cairo, are Beni Suef, Minia, Assiut, Akhmim, Suhag, Girga, Kena, Luxor, Esna, Edfu, Assuan and Korosko. Beni Suef, 77 m. from Cairo by rail, is the capital of a *mudiria* and a centre for the manufacture of woollen goods. Minia, 77 m. by rail farther south is also the capital of a *mudiria*, has a considerable European colony, possesses a large sugar factory and some cotton mills. Assiut, 235 m. S. of Cairo by rail, is the most important commercial centre in Upper Egypt. At this point a barrage is built across the river. Suhag, 56 m. by rail S. of Assiut, is the headquarters of Girga *mudiria* and has two ancient and celebrated Coptic monasteries in its vicinity. A few miles above Suhag, on the opposite (east) side of the Nile is Akhmim, where silk and cotton goods are made. Girga, 22 m. S. by rail of Suhag, is noted for its pottery. Kena, on the east bank of the Nile, 145 m. by rail from Assiut, is the chief seat of the manufacture of the porous earthenware water-bottles used all over Egypt. Luxor, 418 m. from Cairo, marks the site of Thebes. Esna is another place where pottery is made in large quantities. It is on the west bank of the Nile 36 m. by rail south of Luxor

THE PYRAMID OF KHEFREN, GIZEH, EGYPT

The pyramid of Khefren (Kha-f-Ra, IV. dynasty), perpendicular height 447½ ft., is the second largest of the three great pyramids of Gizeh. At the top a small fragment remains of the original coating of limestone and unpolished granite slabs

and Edfu 30 m farther south is chiefly famous for its ancient temple. Aswan is at the foot of the First Cataract and 55[illegible] m. S. of Cairo by rail. Three miles farther south, at Shellal, the Egyptian railway terminates. Korosko, 118 m. by river above Aswan, was the northern terminus of the old caravan route from the Sudan across the Nubian desert.

Ancient Cities and Monuments.—To many visitors the remains of Egypt's remote past are of deeper interest than the activities of her modern cities. They will find the present and the past closely mingled: for the larger towns of to-day are, in many cases, built on the sites of ancient cities, and they generally contain some monuments of the time of the Pharaohs, Greeks or Romans. The sites of other ancient cities now in complete ruin may be indicated. Memphis, the Pharaonic capital, was on the west bank of the Nile, some 14 m. above Cairo, and Heliopolis lay some 5 m. N.N.E. of Cairo. The pyramids of Giza or Gizeh, on the edge of the desert, 8 m. W. of Cairo, are the largest of the many pyramids and other monuments, including the famous Sphinx, built in the neighbourhood of Memphis. Thebes has been replaced in part by Luxor. Syene stood near to where the town of Aswan now is; opposite, on an island in the Nile, are scanty ruins of the city of Elephantine, and a little above, on another island, is the temple of Philae. The ancient Coptos (Keft) is represented by the village of Kuft, between Luxor and Kena. A few miles north of Kena is Dendera, with a famous temple. The ruins of Abydos, one of the oldest places in Egypt, are 8 m. S.W. of Balliana, a small town in Girga *mudiria*. The ruined temples of Abu Simbel are on the west side of the Nile, 56 m. above Korosko. On the Red sea, south of Kosseir, are the ruins of Myos Hormos and Berenice. Of the ancient cities in the Delta there are remains, among others, of Sais, Iseum, Tanis, Bubastis, Onion, Sebennytus, Pithom, Pelusium, and of the Greek cities Naucratis and Daphnae. There are, besides the more ancient cities and monuments, a number of Coptic towns, monasteries and churches in almost every part of Egypt, dating from the early centuries of Christianity. The monasteries, or *ders*, are generally fort-like buildings and are often built in the desert. Tombs of Mohammedan saints are also numerous, and are often placed on the summit of the cliffs overlooking the Nile. The traveller in Egypt thus views, side by side with the activities of the present day, memorials of every race and civilization which has flourished in the valley of the Nile.

SOCIOLOGICAL CHARACTERISTICS

Races and Religion.—The population is generally divisible into (1) the *fellahin* or peasantry, and the townsmen of the same blood: Mohammedans and Copts far predominating in both cases; (2) the Bedouins, or nomad Arabs of the desert, comprising the Arabic-speaking tribes who range as far south as 26° N., and the racially distinct tribes (Hadendowa, Aisharin, Ababda, *etc.*) inhabiting the desert from Kosseir to Suakin: (3) the Nuba Nubians or Berberin, who occupy the Nile valley between Aswan and Dongola: they are mainly agriculturists, though they take kindly to trading, and seem to be chiefly of mixed negro and Arab blood; and (4) foreigners, over 150,000 in number, and chiefly Greeks, whose great centre is Alexandria—Italians, British and French. Syrians and Levantines abound, and there is a Persian colony. The Turkish element is only a few thousand strong, but holds a high social position.

The great majority of the people are Mohammedans (11,624,000 out of 12,718,000 in 1917). Christians in 1917 numbered 1,026,000, composed mainly of Copts (857,000), with an admixture of Armenian, Syrian and Maronite sects, Roman Catholics (108,000) and a variety of Protestant bodies (47,000). There were 60,000 Jews at the same census.

The Mohammedans are Sunnites, principally of the persuasion of the *Shafi'is*, whose celebrated founder, the imam ash-Shafi'i, is buried in the great southern cemetery of Cairo. Many of them are, however, *Hanifis* (to which persuasion the Turks chiefly belong), and in parts of Lower, and almost universally in Upper, Egypt, *Malikis*. Among the Muslims the *Sheikh-el-Islam*, appointed by the khedive from among the *Ulema* (learned class), exercises the highest religious and, in certain subjects, judicial authority. Valuable property is held by the Mohammedans in trust for the promotion of religion and for charitable purposes, and is known as the Wakfs administration. The revenue derived is over £250,000 yearly.

The Coptic organization is ruled by the Patriarch of Alexandria, whose jurisdiction extends over Ethiopia also, and who is assisted by three metropolitans and twelve bishops.

Manners and Customs.—In physique the Egyptians are of full average height (the men are mostly 5 ft. 8 in. or 5 ft. 9 in.), and both sexes are remarkably well proportioned and strong. The Cairenes and the inhabitants of Lower Egypt generally have a clear complexion and soft skin of a light yellowish colour: those of Middle Egypt have a tawny skin, and the dwellers in Upper Egypt a deep bronze or brown complexion. The face of the men is of a fine oval, forehead prominent but seldom high, straight nose, eyes deep set, black and brilliant, mouth well formed, but with rather full lips, regular teeth beautifully made, and beard usually black and curly but scanty. Moustaches are worn, while the head is shaved save for a small tuft (called *shusheh*) upon the crown. As to the women, "from the age of about 14 to that of 18 or 20, they are generally models of beauty in body and limbs; and in countenance most of them are pleasing, and many exceedingly lovely; but soon after they have attained their perfect growth, they rapidly decline." Tattooing is common with both sexes, and the women stain their hands and feet with henna.

Dress is being materially altered, at least in urban society, by the growing adoption of European clothing, and by the emancipation of women from a seclusion which was symbolized in the obscuring character of their outdoor raiment. Among the men of the upper and middle classes who retain their old practice, the ordinary dress consists of cotton drawers, and a cotton or silk shirt with very wide sleeves. Above these are generally worn a waistcoat without sleeves, and a long vest of silk, called kaftan, which has hanging sleeves, and reaches nearly to the ankles. The kaftan is confined by the girdle, which is a silk scarf, or cashmere or other woollen shawl. Over all is worn a long cloth robe, the gibbeh (or jibbeh) somewhat resembling the kaftan in shape, but having shorter sleeves, and being open in front. The dress of the lower orders is the shirt and drawers, and waistcoat, with an outer shirt of blue cotton or brown woollen stuff; some wear a kaftan. The head-dress is the red cloth fez or tarbush round which a turban is usually worn. Men who have otherwise adopted European costume retain the tarbush. The fellahin wear nothing but drawers and a long blue gown of linen or cotton, with a belt, and in cold weather a coarse brown cloak over all. Many professions and religions, *etc.*, are distinguished by the shape and colour of the turban, and various classes, and particularly servants, are marked by the form and colour of their shoes; but the poor go usually barefoot. An increasing number of ladies of the upper classes now dress in European style, with certain modifications, such as the head-veil, though its use is now being largely abandoned in the cities. Those who retain native costume wear a very full pair of silk trousers, bright coloured stockings (usually pink), and a close-fitting vest with hanging sleeves and skirts, open down the front and at the sides, and long enough to turn up and fasten into the girdle, which is generally a cashmere shawl; a cloth jacket, richly embroidered with gold, and having short sleeves, is commonly worn over the vest. The women of the lower orders have trousers of printed or dyed cotton, and a close waistcoat. All wear the long and elegant head-veil. This is a simple "breadth" of muslin, which passes over the head and hangs down behind, one side being drawn forward over the face in the presence of a man. A lady's veil is of white muslin, embroidered at the ends in gold and colours; that of a person of the lower class is simply dyed blue. It is intended to conceal all the features save the eyes. Ladies use slippers of yellow morocco, and abroad, inner boots of the same material, above which they wear, in either case, thick shoes, having only toes. The poor wear red shoes, very like those of the men. The women, especially in Upper Egypt, not infrequently wear nose-rings.

The principal meals are breakfast, about an hour after sunrise; dinner, or the mid-day meal, at noon; and supper which is the

[illegible] a little after sunset. Pastry, sweetmeats and fruit are highly esteemed. Coffee is taken at all hours, and is, with a pipe, presented at least once to each guest. Tobacco is the great luxury of the men of all classes in Egypt, who begin and end the day with it and generally smoke all day with little intermission. Many women, also, especially among the rich, adopt the habit.

In social intercourse the Egyptians observe many forms of salutation and much etiquette; they are very affable, and readily enter into conversation with strangers. Their courtesy and dignity of manner are striking, and are combined with ease and a fluency of discourse. They have a remarkable quickness of apprehension, a ready wit and a retentive memory. They are fatalists, and bear calamities with surprising resignation. Filial piety, respect for the aged, benevolence and charity are conspicuous in their character. Humanity to animals is another virtue, and cruelty is openly discountenanced in the streets. Their cheerfulness and hospitality are remarkable, as well as frugality and temperance in food and drink, and honesty in the payment of debt. Their cupidity is mitigated by generosity; their natural indolence by the necessity, especially among the peasantry, to work hard to gain a livelihood.

The amusements of the people are generally not of a violent kind, being in keeping with their sedentary habits and the heat of the climate. The bath is a favourite resort of both sexes and all classes. Notwithstanding its condemnation by Mohammed, music is the most favourite recreation of the people; the songs of the boatmen, the religious chants, and the cries in the streets are all musical. There are male and female musical performers; the former are both instrumental and vocal, the latter (called *'Almeh*, pl. *'Awālim*) generally vocal. The 'Awālim are, as their name ("learned") implies, generally accomplished women, and should not be confounded with the Ghawāzi, or dancing-girls. There are many kinds of musical instruments. The music, vocal and instrumental, is generally of little compass, and in the minor key; it is therefore plaintive, and strikes a European ear as somewhat monotonous, though often possessing a simple beauty, and the charm of antiquity, for there is little doubt that the favourite airs have been handed down from remote ages. Many of the dancing-girls of Cairo to-day are neither 'Awālim nor Ghawāzi, but women of the very lowest class whose performances are both ungraceful and indecent. A most objectionable class of male dancers also exists, who imitate the dances of the Ghawāzi, and dress in a kind of nondescript female attire. Not the least curious of the public performances are those of the serpent-charmers, who are generally Rifā'ia (Saadia) dervishes. Their power over serpents has been doubted, yet their performances remain unexplained; they, however, always extract the fangs of venomous serpents. Jugglers, rope-dancers and farce-players must also be mentioned. In the principal coffee-shops of Cairo are to be found reciters of romances, surrounded by interested audiences.

The first ten days of the Mohammedan year are held to be blessed, and especially the tenth. On the tenth day, being the anniversary of the martyrdom of Hosain, the son of Ali and grandson of the Prophet, the mosque of the Hasanen at Cairo is thronged to excess, mostly by women. In the evening a procession goes to the mosque, the principal figure being a white horse with white trappings, upon which is seated a small boy, the horse and the lad, who represents Hosain, being smeared with blood. From the mosque the procession goes to a private house, where a mullah recites the story of the martyrdom. Following in order of the [illegible] year the next festival is that of the Return of the Pilgrims, which is the occasion of great rejoicing, many having friends or relatives in the caravan. The Mahmal, a kind of covered litter, [illegible] is brought into the city in procession, though not with so much pomp as when it leaves with the pilgrims. The Birth of the Prophet (Molid en-Nebi), which is celebrated at the beginning of the third month, is the greatest festival of the whole year. For nine days and nights Cairo [illegible] officials, and of the dervishes. Next in time, and also in importance, is the Molid El-Hasanen, commemorative of the birth of Hosain, and lasting 15 days and nights; and at the same time is kept the Molid of al-Ṣaliḥ Ayyub, the last sovereign but two of the Ayyubite dynasty. In the seventh month occur the Molid of the sayyida Zenab, and the commemoration of the Miarag, or the Prophet's miraculous journey to heaven. Early in the eighth month (Sha'ban), the Molid of the imam Shafi'i is observed; and the night of the middle of that month has its peculiar customs being held by the Mohammedans to be that on which the fate of all living is decided for the ensuing year. Then follows Ramadan the month of abstinence, a severe trial to the faithful; and the Lesser Festival (Al-'id aṣ-ṣaghir), which commences the new month of Shawwal, is hailed by them with delight. A few days after, the Kiswa, or new covering for the Ka'ba at Mecca, is taken in procession from the citadel, where it is always manufactured, to the mosque of the Hasanen to be completed; and, later, the caravan of pilgrims departs, when the grand procession of the Mahmal takes place. On the tenth day of the last month of the year the Great Festival (Al-'id al-kabir), or that of the Sacrifice (commemorating the willingness of Ibrahim to slay his son Ismail), closes the calendar. The Lesser and Great Festivals are those known in Turkish as the Bairam (*q.v.*).

The rise of the Nile is naturally the occasion of annual customs, some of which are doubtless relics of antiquity; these are observed according to the Coptic calendar. The commencement of the rise is commemorated on the night of the 11th of Baūna, June 17, called that of the Drop (Lelet-en-Nukta), because a miraculous drop is then supposed to fall and cause the swelling of the river. The real rise begins at Cairo about the summer solstice, or a few days later, and early in July a crier in each district of the city begins to go his daily rounds, announcing, in a quaint chant, the increase of water in the nilometer of the island of Roda. When the river has risen 20 or 21 ft., he proclaims the Wefa en-Nil, "Completion" or "Abundance of the Nile." The crier continues his daily rounds, with his former chant, excepting on the Coptic New Year's Day, when the cry of the Wefa is repeated, until the Salib, or Discovery of the Cross, Sept. 26 or 27, at which period, the river having attained its greatest height, he concludes his annual employment with another chant, and presents to each house some limes and other fruit, and dry lumps of Nile mud.

Tombs of saints abound, one or more being found in every town and village; and no traveller up the Nile can fail to remark how every prominent hill has the sepulchre of its patron saint. The great saints of Egypt are the imam Ash-Shafi'i, founder of the persuasion called after him, the sayyid Ahmad al-Baidawi, and the sayyid Ibrahim ed-Desuki, both of whom were founders of orders of dervishes. Egypt holds also the graves of several members of the Prophet's family, the tomb of the sayyida Zeyneb, daughter of 'Ali, that of the sayyida Sekeina, daughter of Hosain, and that of the sayyida Nefisa, great-granddaughter of Hasan, all of which are held in high veneration. The mosque of the Hasanen (or that of the "two Hasans") is the most reverenced shrine in the country, and is believed to contain the head of Hosain. Many orders of Dervishes live in Egypt, all presided over by a direct descendant of the caliph Abu Bekr, called the Sheikh el-Bekri. The Saadia are famous for charming and eating live serpents, etc., and the 'Ilwania for eating fire, glass, etc. The Egyptians firmly believe in the efficacy of charms, a belief associated with that in an omnipresent and over-ruling providence. Thus the doors of houses are inscribed with sentences from the Koran, or the like, to preserve from the evil eye, or avert the dangers of an unlucky threshold; similar inscriptions may be observed over most shops, while almost every one carries some charm about his person. The so-called sciences of magic, astrology and alchemy still flourish.

GOVERNMENT

The national flag of Egypt is green and has a white crescent enclosing three five-pointed white stars between its horns.

LONDON PHOTOGRAPHS, (1, 2, 4, 5, 6, 7, 8) DONALD MCLEISH

ANCIENT AND MODERN EGYPT

airo, the largest and among the oldest of
he surrounding district is flooded period-
for purposes of irrigation

the great temple of Ammon at Karnak,
left bank of the Nile

e Moeris, Fayum

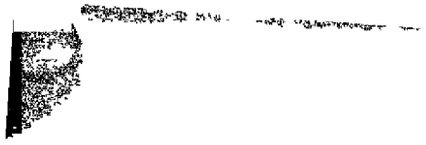
the largest of the pyramids at Gizeh

t Luxor, built about 1400 B.C. The vast-
h of the fourteen pillars is 52 feet high)
e most impressive relics of ancient Egypt

6. Cairo. The Mosque of Kierbeh in the middle
that of Agha, popularly known as the Blue M

7. Outer court and one of the west pylons of the T
dating in its final form from the Ptolemaic pe
It is one of the last as well as the best preser
acteristic of the ancient Egyptian style

8. Colossi of Memnon, Thebes. That to the left
Memnon," from the belief that in Roman
musical note at sunrise



in an independent State under a hereditary monarch with the title of king (now Fuad I.) are known in detail under the section *History*. The exact measure of Egypt's independence remains unsettled so long as no agreement is reached on the points reserved in the unilateral declaration by which Great Britain recognized Egypt as a sovereign State. Equally unsettled is the distribution of constitutional power within the country. In theory, the central administration is carried on by a cabinet of ministers appointed by the king, and supplemented for consultative purposes by two British advisers in matters of finance and justice. By the Constitution of 1923 legislative power is exercised by the king in concurrence with the parliament: but in 1928 the king by edict dissolved parliament and forbade it from assembling again for three years; the former system of legislation by royal rescript being thus reverted to. The parliament, when it functions, consists of two houses, a senate, of which two-fifths of the members are nominated, and a chamber of deputies, elected on the basis of one member for every 60,000 inhabitants.

For purposes of local government the chief towns constitute governorships (*moafzas*), the rest of the country being divided into *mudirias* or provinces. The governors and *mudirs* (heads of provinces) are responsible to the ministry of the interior. The provinces are further divided into districts, each of which is under a *mamur*, who in his turn supervises and controls the *omda*, mayor or head-man, of each village in his district.

The governorships are: Cairo, Alexandria, which includes an area of 70 sq.m.; Suez canal, including Port Said and Ismailia; Suez and El-Arish; the Western desert; the Southern desert; Sinai; and the Red sea coast. Lower Egypt is divided into the provinces of: Behera, Gharbia, Menufia, Dakahlia, Kaliubia, Sharkia. The oasis of Siwa and the country to the Tripolitan frontier are dependent on the province of Behera. The provinces of Upper Egypt are: Giza, Beni Suef, Fayum, Minia, Assiut, Girga, Kena, Aswan. The peninsula of Sinai is administered by the War Office.

Justice.—There are four judicial systems in Egypt: two applicable to Egyptian subjects only, one applicable to foreigners only, and one applicable to foreigners and, to a certain extent, Egyptians, also. This multiplicity of tribunals arises from the fact that, owing to the Capitulations, which apply to Egypt as having belonged to the Turkish empire, foreigners are almost entirely exempt from the jurisdiction of the native courts. It will be convenient to state first the law under the old régime as regards foreigners, and secondly the law which concerns Egyptians; though it will be understood that the position regarding the Capitulations is in a state of flux, with the movement of Egypt towards independence. Criminal jurisdiction over foreigners is exercised by the consuls of those Powers possessing such right by treaty, according to the law of the country of the offender. These consular courts also judge civil cases between foreigners of the same nationality.

Jurisdiction in civil matters between Egyptians and foreigners and between foreigners of different nationalities is no longer exercised by the consular courts. The grave abuse to which the consular system was subject led to the establishment, in Feb. 1876, at the instance of Nubar Pasha and after eight years of negotiation, of International or "Mixed" Tribunals to supersede consular jurisdiction to the extent indicated. The Mixed Tribunals, composed of both foreign and Egyptian judges, employ a code based on the *Code Napoléon* with such additions from Mohammedan law as are applicable. In certain designated matters they enjoy criminal jurisdiction, including, since 1900, offences against the bankruptcy laws. Cases have to be conducted in Arabic, French, Italian or English. Besides their judicial duties, the courts practically exercise legislative functions, as no important law can be made applicable to Europeans without the consent of the powers, and the powers are mainly guided by the opinions of the judges of the Mixed Courts.

The judicial systems applicable solely to Egyptians are supervised by the Ministry of Justice, to which has been attached since 1890 a British judicial adviser. Two systems of laws are administered:—(1) the *Mehkemehs*, (2) the Native Tribunals. The *mehkemehs* or courts of the cadis, judge in all matters of personal status, such as marriage, inheritance and guardianship and are guided in their decisions by the code of laws founded on the Koran. The grand cadi, who must belong to the sect of the *Hanifis*, sits at Cairo, and is aided by a council of *Ulema* or learned men. This council consists of the sheikh or religious chief of each of the four orthodox sects, the sheikh of the mosque of Azhar, who is of the sect of the *Shafi'is*, the chief (*nakib*) of the *Sherifs*, or descendants of Mohammed, and others. The cadis are chosen from among the students at the Azhar university. (In the same manner, in matters of personal law, Copts and other non-Mohammedan Egyptians are, in general, subject to the jurisdiction of their own religious chiefs.)

For other than the purposes indicated, the old indigenous judicial system, both civil and criminal, was superseded in 1884 by tribunals administering a jurisprudence modelled on that of the French code. The system was on the advice of an Anglo-Indian official (Sir John Scott), modified and simplified in 1891, but its essential character remained unaltered. In 1904, however, more important modifications were introduced. Save on points of law, the right of appeal in criminal cases was abolished, and assize courts, whose judgments were final, established. At the same time the penal code was thoroughly revised, so that the Egyptian judges were "for the first time provided with a sound working code." There are courts of summary jurisdiction presided over by one judge, central tribunals (or courts of first instance) with three judges, and a court of appeal at Cairo. A committee of judicial surveillance watches the working of the courts of first instance and the summary courts, and endeavours, by letters and discussions, to maintain purity and sound law. There is a *procureur-général*, who, with other duties, is entrusted with criminal prosecutions. His representatives are attached to each tribunal, and form the *parquet* under whose orders the police act in bringing criminals to justice. In the *markak* (district) tribunals, created in 1904 and presided over by magistrates with jurisdiction in cases of misdemeanour, the prosecution is, however, conducted directly by the police. Special children's courts have been established for the trial of juvenile offenders.

The police service is under the orders of the Ministry of the Interior, though the provincial police are largely under the direction of the local authorities, the *mudirs* or governors of provinces, and the *mamurs* or district officials; to the *omdas*, or village headmen, who are responsible for the good order of the villages, a limited criminal jurisdiction has been entrusted.

SOCIAL SERVICES

Education.—Two different systems of education exist, one founded on indigenous lines, the other European in character. Both systems are more or less fully controlled by the ministry of public instruction. The Government has primary, secondary and technical schools, training colleges for teachers, and colleges of commerce, education, agriculture, engineering, law, medicine and veterinary science. The Government system, which dates back to a period before the British occupation, is designed to provide, in the main, a European education. In the primary schools Arabic is the medium of instruction, the use of English for that purpose being confined to lessons in that language itself. The school of law is divided into English and French sections according to the language in which the students study law. Besides the Government primary and secondary schools, there are many other schools in the large towns owned by the Mohammedans, Copts, Hebrews, and by various missionary societies, and in which the education is on the same lines. A movement initiated among the leading Mohammedans led in 1908 to the establishment as a private enterprise of a national Egyptian university devoted to scientific, literary and philosophical studies.

The indigenous system of education culminates in the university mosque of el-Azhar, the largest and most important of seven well-endowed Mohammedan institutions which provide instruction on traditional lines. El-Azhar is regarded as the chief centre of learning in the Mohammedan world. Its subjects of study are mainly the theology of Islam and the complete science of

religious, moral, civil and criminal law as founded on the Koran and the traditions of the Prophet and his successors; but they also include Arabic literature and grammar, rhetoric, logic, versification, and a certain amount of mathematics and physical science. Attempts to reform the direction and curriculum have been uniformly defeated; and of late the el-Azhar has declared itself an organ of advanced nationalism. Its students come from all parts of the Mohammedan world; they pay no fees, and the professors receive no salaries, subsisting mainly by private teaching, the copying of manuscripts and the reciting of the Koran.

All over the country are scattered mosque-schools or *kuttabs* conducted on similar lines. Their pupils are taught to recite portions of the Koran, and most of them learn to read and write Arabic with a little simple arithmetic. Numbers of the *kuttabs* have been taken under Government control, and now provide a good elementary secular education as well as a knowledge of the Koran. Other qualified schools of a similar type receive grants-in-aid, provided Arabic is taught. The number of pupils in private schools under Government inspection was, in 1898, the first year of the grant-in-aid system, 7,536; in 20 years time it had grown to over 300,000. The Copts have over 1,000 primary schools, in which the teaching of Coptic is compulsory, a few industrial schools, and a college for higher education. There are also special schools for the teaching of Mohammedan religious law and the instruction of sheikhs.

As elsewhere, the competing demands upon the taxpayer have restricted the funds available for purposes of national education. Until the change in 1922 of the status of the country the Government's policy may be described as a general concentration upon the development and encouragement of mosque schools, and primary education and the maintenance of a few secondary schools in Cairo and Alexandria, intended to serve as nuclei and models for the conduct of secondary education by the local educational authorities (provincial councils), Mohammedan educational trusts and private enterprise. Since the school year 1922–23 there has been a definite move towards taking over secondary schools and direct assumption of the development of secondary education by the State.

The provision of higher and general professional education has throughout been left to the State and effected in a series of separate schools under various Ministries. Some of these schools, notably the School of Medicine at Qasr el Aini, have acquired more than a local reputation; but the local demand for higher education is great, and many Egyptian students go to Europe and America to obtain it.

The desirability of uniting the above institutions as faculties of a modern Egyptian university has long been under consideration, and was reported on favourably in detail by a special commission in 1921. Owing, however, largely to difficulties in securing suitable accommodation and to differences in regard to means of government and methods of teaching, the realization of the project has been continuously delayed. Although these difficulties have only been partially overcome, the formal and administrative incorporation of the specified higher schools to constitute a university was enacted by royal decree in March 1925.

Public Health.—All the capital towns of the *mudirias* (provinces) have now been furnished with up-to-date water supplies, either of filtered or of deep well-water, besides many other of the larger towns. As efficient water supplies were installed, water-carriage drainage followed, and it was found that main drainage systems had to be undertaken in order to prevent the land becoming sewage-logged. Drainage systems have now been installed in Cairo, Alexandria, Port Said, Suez and several other of the larger towns. Establishments coming under the law dealing with "Etablissements insalubres, incommodes et dangereux," which corresponds roughly to the British Factory Acts, are now registered and are visited by special inspectors. A new "milk law," controlling the collection, distribution and sale of milk, and laying down standards for the fat-content, etc., has been drawn up, as well as a "pure food law."

Very great progress has been made in the prevention and control of epidemic disease. Plague, both bubonic and pneumonic, has been reduced to practically negligible proportions. The whole organization for the prevention and combating of cholera epidemics has been remodelled and, although infection has frequently been brought into the country from infected areas, cholera has been prevented from developing into epidemic form, partly owing to an excellent system of port control. Typhus and relapsing fever have been combated on modern lines, and by means of careful delousing of patients and contacts the number of cases in the country have been enormously reduced. Systematic vaccination with revaccination in infected areas has now reduced small pox to an almost negligible quantity.

In 1918 an Anti-Malaria Commission was instituted, on which the irrigation and main drainage and public health departments are represented, and a great deal of work in draining and filling in swamping areas has already been completed in districts known to be malarial. Active campaigns have now been started against ankylostomiasis and bilharzia, and travelling hospitals and dispensaries are at work throughout the country treating the infected peasants.

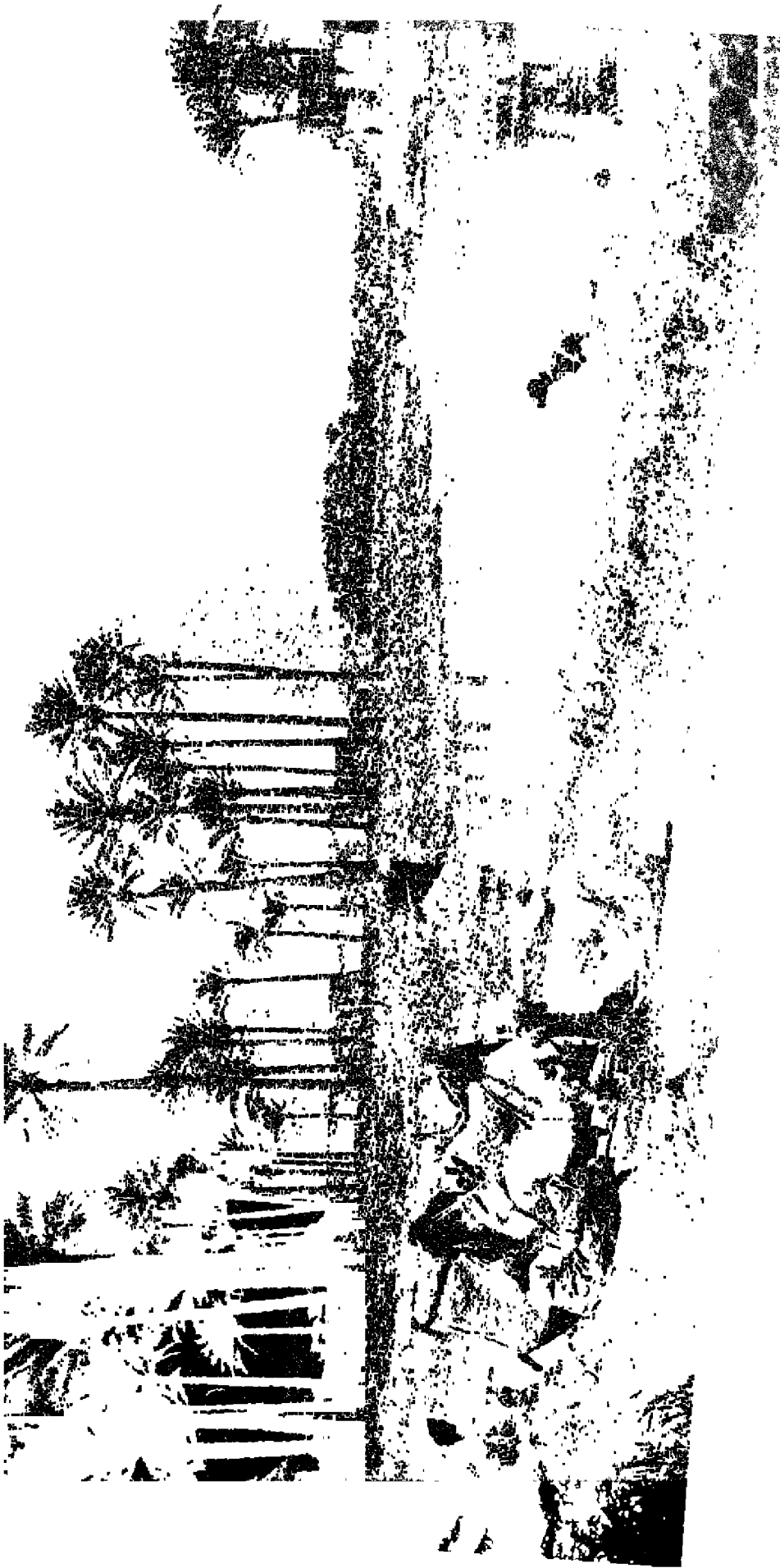
A large number of ophthalmic hospitals have been built and opened throughout the country, and there is now a permanent ophthalmic hospital in every provincial capital. The Imperial War Graves Commission have built an ophthalmic research laboratory as a memorial to the men of the Egyptian Labour Corps and Camel Transport Corps who gave their lives in the World War. A new general hospital of modern design has been opened at Damietta. Dispensaries now exist in all the *markaz* towns and free medical treatment is given to the poor. A new pharmacy law has been promulgated, as also a law controlling the importation and sale of stupefacient drugs. Under the new law, firms importing cocaine operate under licence, and are to all intents and purposes rationed.

A number of children's dispensaries (welfare centres) and maternity homes for the poor have been opened all over the country, though the infantile mortality is still high. Housing and town-planning are receiving increased attention and an interesting experiment in laying out a model industrial settlement may now be seen at Port Fuad, immediately opposite Port Said.

ARCHAEOLOGY AND ART

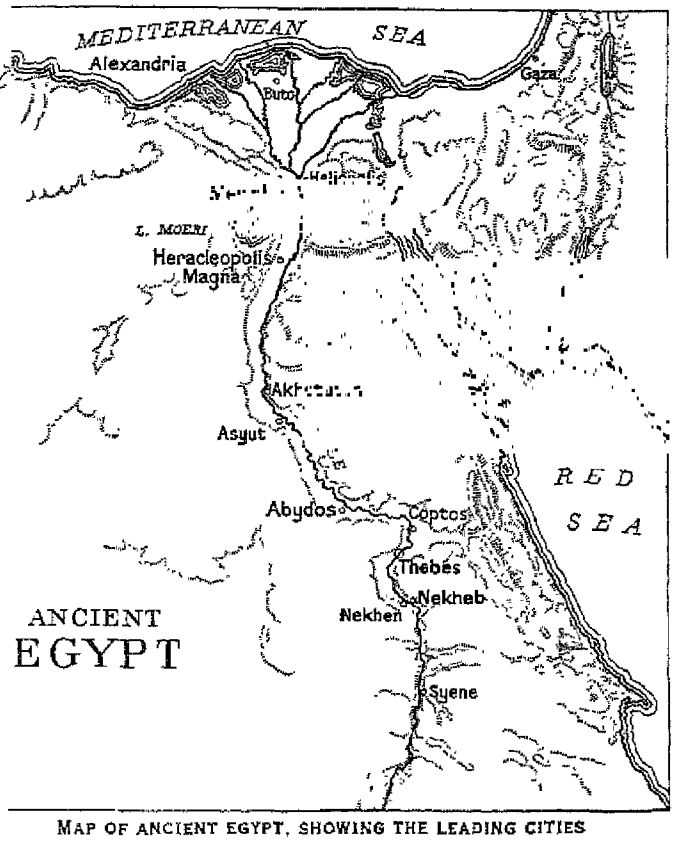
1. Archaeology and Excavation.—In Egypt archaeology has won its greatest triumphs and has developed into a science that has imparted its rules and methods of work to the archaeologists in the older fields. The reason is the preservative climate of Egypt, the absence of damp, and the certainty of fine weather, that keeps things intact which would perish elsewhere, and enables the excavator to count upon absolute security of work uninterrupted by bad climatic conditions. It is through excavation in Egypt that archaeology has developed as it has during the last fifty years. There was no real excavation in Egypt, other than the opening of tombs, till the 'fifties and 'sixties of the 19th century, when the names of Rhind and of Mariette mark the beginnings. Modern archaeological investigation begins in Egypt with Naville and Petrie when the Egypt Exploration Society began to work, in the early eighties. And it is to Petrie in succession to Rhind that the "codification" of the art of Egyptian digging, so to speak, and its assumption of a scientific character, is due. Petrie was the first, after Rhind, to insist on accurate record of all finds, however insignificant they might appear to be, for who knows what thing, apparently insignificant now, might not be regarded as enormously significant by archaeologists of the future? His systematic style of work has since been adopted in various forms by numberless disciples, imitators, adapters and critics, some of whom are much more meticulously "scientific" than their model, while others think that they can take what is good from his work while dropping what they consider unnecessary labour in recording things already known almost *ad nauseam*, especially if they possess no virtue other than that of being ancient. Others would strictly confine the business of recording finds to the European observers, leaving nothing even to a trained native.

In the 45 years that have elapsed since the first work was done for the Egypt Exploration Fund in the Delta, the original excavators have seen grow up a great *corpus* of archaeological knowledge of ancient Egyptian civilization and history that depends



almost entirely on scientific excavation.

Britain, America, France, Germany and Italy have all contributed to the list of actual excavators, while Russia, Holland, Belgium and the Scandinavian countries have also added a number of scientific students of Egyptology. And the methods and aims of Egyptian archaeology have been passed on first to the Greek and international workers in Greece (with especial brilliance of



MAP OF ANCIENT EGYPT, SHOWING THE LEADING CITIES

results under Evans in Crete), then to Italy and the West, later to Mesopotamia and lastly to India. China still awaits scientific excavation, although Chinese Turkestan has already known it with magnificent results at the hands of Sir Aurel Stein and Dr. von Lecoq. And in Chinese Turkestan we obtain results most analogous to those gained in Egypt, owing to the resemblance of the climate of the two countries; though one is hot and the other cold, both are phenomenally dry. The methods in use in Egypt have, with necessary modifications owing to varying local conditions been adopted everywhere. They are the methods of common sense, of accuracy in record and in fact of the scientific conscience, without which antiquarians are still mere dilettanti. The scientific man wishes to know accurately what was; he should have no preconceived ideas of what ought to have been; he should have none but an ordered enthusiasm for truth, and should have a metaphorical jug of cold water ready for all undisciplined and illiterate enthusiasms. Irrational theories about Egypt, whether dealing with the Great Pyramid, an Unlucky Mummy or "Mummy Wheat" are unhappily very popular, and the scientific archaeologist often has to deal very patiently with believers in ideas of this kind, connected with prophecies, ghosts and other pseudo-religious or "occult" phenomena, with which science, which is never muzzy, "occult" or obscurantist, makes no muddles, and dignifies them as "mysteries," as hard and clear as the Greek day, has nothing to do.

We have, in fact, to investigate ancient Egypt rather with the Greek spirit of clarity and naked truth than with the Semitic spirit of enthusiastic belief in veiled mysteries, or the ancient Egyptian spirit of muddleheadedness which makes such an appeal nowadays.

While it is to Egyptian excavation that archaeology owes its scientific system, it is of course not the fact that Egyptian archaeological [illegible] e owes all its knowledge to the art of excavation. We always had the evidence of the classical writers in Egypt, chief of them of course Herodotus, whose account of Egypt is read by none with greater pleasure and instruction than by a modern archaeologist. It is not always accurate, it is often superficial, but as a contemporary witness it is incomparable. We had the epitomes of the work of the Egyptian priest Manetho on the dynasties of Egypt; his scheme of dynasties, garbled as the royal names have been by copyists, has survived all archaeological discovery, has proved to fit the facts, is retained by all modern historians of ancient Egypt. We have the references of many classical writers to the mysteries of Egyptian religion They may have thought that they were explaining that marvellous welter of conflicting beliefs satisfactorily to their contemporaries; modern writers have thought they were doing the same thing. But anybody can find in the Egyptian religion whatever he wants to find in it. To the scientific observer it seems so confused and self-contradictory as to deter him from wasting his time in trying to clear up the muddle; he would be ploughing the sands. Only description is possible (*see* below).

Then in modern times the decipherment of the hieroglyphs begun by Young and Champollion in 1821, and put on the basis of firm knowledge by the latter, enabled the *savants* swiftly to gain a more accurate knowledge of the religion and, with the dynastic skeleton of Manetho to help make acquaintance with the flesh and blood of history derived from the monuments of the Egyptians themselves. Wilkinson and Lepsius, and after them Birch and Brugsch, are the greatest names associated with the early historical work, and Lepsius, as the result of his labour with the royal Prussian expedition to Egypt in the 'forties, was the greatest of these. Gliddon was the first to talk about the new discoveries in America in the 'thirties, and Wilkinson was the first to make the new knowledge really accessible to the educated public of Britain and the United States by his famous "Manners and Customs of the Ancient Egyptians" (first published in 1837 and re-edited by Birch in 1878), a book which has probably made not only Egyptian archaeology, but archaeology generally, familiar to many who otherwise would never have realized its enthralling interest. Though he never excavated in the modern manner, but only probed for and dug out tombs in the Theban hillside, and probably did not observe or record with anything like the care that is considered necessary nowadays, Wilkinson may be considered the father of Egyptian archaeology, as Champollion was the father of Egyptian philology. And the Egyptologists proper, the philologists, were hard at work deciphering the hieroglyphed monuments and the hieratic papyri; Birch, Goodwin, Brugsch, de Rouge, Chabas are the greatest names. We knew a great deal before the days of scientific excavation, from the monuments above ground, in Egypt and in our museums, and the relics discovered in Theban tombs. Bonaparte's great expedition in 1798 with his attendant *savants* and the resultant publication of the great "Description de l'Egypte" had directed the attention of the world to ancient Egypt, and initiated the work that culminated in Champollion's discovery, after which a real furore set in for the collection of Egyptian monuments, the bigger the better, for European Museums. Men like Salt, Belzoni and Drovetti collected indiscriminately, with the result that, for instance, the British Museum has been saddled with dozens of figures of the lioness-headed goddess Sekhmet (many of them in quite bad repair) from Thebes, whereas two or three good ones would have sufficed. Then the era of scientific investigation and collection begins with the expedition of the French and Tuscan Governments, under Champollion and Rosellini in 1827, and then came the famous Prussian expedition of Lepsius (1843) which brought back objects chosen with discrimination and studied them on the spot, and in the great *Denkmäler* (1851)—still one of our chief sources of inscriptional material—produced the first scientific work on ancient Egypt on the grand scale. Meanwhile, Wilkinson had lived and dug his tombs at Thebes, where Rhind followed him Then came the new régime of Mariette in 1858. Egypt ceased to be a happy hunting ground of collectors; a Museum of Antiquities was founded and established first at Būlāq, a suburb of Cairo and everything found had to go there

This exclusive policy in the 'sixties and 'seventies and the strict confinement of excavation to Mariette and the Būlāq museum, [illegible] the galleries of the new museum with a wonderful collection of antiquities, especially of the Old Kingdom. But the return to a more liberal system after Mariette's death in 1881 and [illegible] British occupation in 1882 and the concession of the right to excavate to properly accredited museums and learned societies, such as the Egypt Exploration Fund, during the almost fifty years of its existence, has actively fostered the contemporary growth [illegible] archaeological science, has enriched museums with scientifically recorded material (hardly known before), and has proved in no way prejudicial to the national museum of Egypt, which under the [illegible] of Maspero, that of de Morgan and others, has probably trebled its collections as they were left by Mariette. From Bulaq the Museum had to move to Gizeh and then to the great new building at Kasr-el-Nil. It has only gained by the introduction of international co-operation and the equitable division of [illegible], one half to the museum, the other to the excavator. Return to a less liberal system, by which the museum may take what it likes, all if it likes, of what an European or American expedition finds, will inevitably react unfavourably both on the museum's progress and on archaeological progress generally. It is an elementary consideration that the subscribers to archaeological expeditions will cease to subscribe if they see no return for their money in their own museums.

During the last fifty years the "surface" knowledge, good as it was, the result of decades of work by great scholars, has been reinforced and completed by the knowledge derived from scientifically-directed excavations, with the result that we now know far more of the archaeology of Ancient Egypt than of any other country, not excepting Greece and Italy. For the damper climates of Greece and Italy have not been able to preserve for us all the actual objects, even things of filmy linen, textiles, everything that men used in those remote days, the furniture and the rest, made of wood, that elsewhere perishes, the last food placed for the dead in the tomb by the mourners. Egypt preserves all intact. Where else could one find a Tutankhamun tomb? It is said that once when a tomb was opened the modern intruders saw, imprinted on the sand covering the floor, the imprints of the feet of the men who had borne the mummy to its tomb four thousand years before.

It is of course not every day that a tomb so inviolate is found. Even that of Tutankhamun seems as a matter of fact, to have been entered by robbers who did not penetrate far into it. The tombs of all the other kings of Thebes were violated long ago, long before Greek times by the Egyptians themselves, who were as consummate hereditary tomb-robbers four thousand years ago as they are now. The tomb of Queen Hetepheres at Gizeh, discovered recently by Reisner, is a case in point. A hieratic papyrus of the 20th Dynasty (1100 B.C.) records the trial of ancient Thebans for the robbery of royal tombs even then. One can only guess the lost magnificence of a tomb of a great king like Seti I. from that which we have from the tomb of an insignificant one like Tutankhamun, and that of the plundered private tombs from the contents of these, found intact by Schiaparelli a few years ago, which are in the Museum of Turin.

The Egyptians were not always buried in stately rock-cut tombs. Excavation has revealed one thing unknown to the older archaeologists—the whole prehistoric or pre-dynastic period, with its weapons of flint, and its crouched bodies in shallow graves. Similar groups were used long after in crowded necropoles, such as Abydos, which are much confused and difficult to dig.

Excavation by no means confines itself to tombs and graves. [illegible] excavation [illegible] more difficult problems [illegible] superimposed and confused graves. The [illegible] presents itself, and often demands the [illegible] skill and careful observation on the part of the excavator [illegible]. This is [illegible], one of the major tasks of the new archaeologist. It presents itself in greater [illegible] in Syria than in Egypt, where superimposed [illegible] of succeeding periods in a [illegible] mound are not so common.

2. Development of Egyptian Civilization As Revealed by Archaeology: the Palaeolithic Period.—The most ancient relics of antiquity in Egypt are the palaeolithic tools of flint and chert found on the lower desert plateaux at the head of the wadis that debouch into the Nile-valley throughout its length in Egypt. These are sometimes found in their *ateliers* where they were originally knapped from the flint boulders that are common in the desert. The most usual form is that of the Acheulian *coup-de poing* or hand-axe. These ancient tools are often deeply patinated by the wind and sun of the ages that have elapsed since they were made. The people who used them evidently lived on the desert margin of the valley, where there was as yet no cultivation, but probably an endless marsh, inundated yearly without check by the rising Nile-flood. We have little proof of much difference in climate from that of to-day. It is not probable that the desert was then covered with humus in which grew trees favoured by a rainier climate; the fossil trees found in the desert belong to an older time when no doubt the climate was in reality different.

The Neolithic Age.—How far these palaeoliths of Egypt were contemporary with those of Northern Europe we do not know. At any rate it does not look as if there was a definite break between the palaeolithic and the neolithic people, who as late as the fifth millennium B.C. lived in the valley. They still used flint and chert, very rarely obsidian. The art of flint-knapping has developed greatly, and in a way peculiar to the Niletes, whose flint and chert weapons are often quite different from those of the rest of the ancient world. They are often chipped with the most extraordinary care, and some knives have a serrated edge so minute as hardly to be visible to the naked eye. They are among the most beautiful of the products of the flint-knapper. The people who made them were not merely hunters, as the palaeolithic folk probably were. They were also pastoralists and, to some extent, agriculturalists. The regulation of the Nile flood and the reclamation of the valley had begun in all probability. Indigenous civilization began slowly to develop. The makers of the flint knives also made stone vessels with the aid of emery (which must have come from abroad, as none is known in Egypt), crude pottery and basket work. The pottery developed, on indigenous lines, like the flint-working, and we have innumerable examples of it, all made without the wheel, in the red and black polished ware, and the less common red ware with white decoration, then later the buff ware with red painted decoration representing ships with oars (rarely sails), men and women and animals, which have been recovered from the shallow graves in which the neolithic people were buried. The bodies were usually wrapped in mats and were placed in a crouching position. They were not mummified in any way, their preservation being due to the dryness of the soil in Upper Egypt; though it is possible that they may sometimes have been smoked. This indigenous culture has been shown by the work of the *Archaeological Survey of Nubia* to have existed in Nubia also where a local form of it persisted so late as the time of the 12th Dynasty. We do not know how long it was before copper made its first appearance in Egypt. We have no absolute chronology of the pre-dynastic period, the age to which the neolithic remains of course belong, and the post-neolithic antiquities up to the time of the union of the kingdom under the First Dynasty, about 3400–3200 B.C. (*see* CHRONOLOGY). But on purely archaeological evidence Prof. Sir Flinders Petrie has devised a scheme of "sequence dating" (*q.v.*) of pre-dynastic antiquities which can be used as a sort of "chronologimeter." So great a number of pre-dynastic necropoles have been excavated that we can trace in them the coming into vogue of various types of flints, pots, stone vases, etc., their period of use, and their gradual disuse, and we can say with comparative certainty that that type of flint and that of vase were in use together, and no other. So at Sequence-date (S.D.) 50 we can say that such-and-such things were in use, and none other. And as we take 1–100 as our gamut, and leave say 1–30 at the beginning for unknown beginnings and say 80–100 at the end of the period for the transition to dynastic styles, we see that S.D. 50 is about the middle of the dynastic period. What actual date S.D. 50 corresponds to of course we do

not know. We think that the first Dynasty began not before 3400 and not much later than 3200 B.C. Prof. Sir Flinders Petrie thinks it began 1460 years earlier (*see* CHRONOLOGY), but he stands alone in this belief, as also does Dr. Borchardt in his unusual date (about 4000 B.C.). A recent writer, Dr Scharff, would bring the date down to about 3000 B.C. And it must be admitted that his arguments are good, and that at any rate it is more probable that the date of the First Dynasty is later than 3400 B.C. than earlier (*see* CHRONOLOGY). The most generally accepted date is *c* 3200 B.C. (Meyer). We may guess that S.D. 50 may represent anything round about 4000 B.C. Now copper is first found at S.D. 38 and a fine copper dagger from Nagada dates between S.D. 55 and 60. The Egyptians therefore ceased to be purely neolithic probably before 4000 B.C. More we cannot say.

The Chalcolithic Age.—It must not be supposed that with the introduction of metal, stone weapons and tools suddenly went out of use. During the whole of the chalcolithic age, from the middle of the pre-dynastic period to the time of the 13th Dynasty, roughly two thousand years, stone was used for commoner purposes, side by side with copper; butcher's knives, for instance, were still made of flint under the 12th Dynasty, and arrow-heads of flint were naturally still used, since it was senseless to waste metal on a weapon that could not be retrieved

The introduction of metal meant a rapid advance in civilization, and by the end of the pre-dynastic period Egypt had developed from a land inhabited by barbarian tribes into a civilized nation with a complicated polity and a culture to which art and even luxury were not unknown. The brain of the nation developed with great speed, and we find that long before the beginning of the 1st Dynasty an astronomical calendar had appeared and must have been first used (*see* CALENDAR) in 4241–4238 B.C., unless with Scharff we suppose that it was first invented a Sothic period later, about 2781–2778 B.C., and in the reign of Zoser of the 3rd Dynasty, whose date he brings down to later than this (*see* CHRONOLOGY). There is no doubt that the impulse to this development, and probably the introduction of metal itself, was due to influences from Syria, and it is probable that already in the middle of the pre-dynastic period the infiltration of non-Nilotic broad-headed foreigners from the North had begun which ended in the domination of the nation by a royal and aristocratic tribe of Asiatics of much higher cranial capacity than the indigenes, who gradually mingled with the Nilotic natives and founded the historical civilization of Egypt. Both elements (and also a third, the Libyan from the West, akin to the Nilote) made their contribution to the common culture; to the indigenous Nilotes belong probably the more distinctly Nilotic and African characteristics, the animal gods for instance, and their representation on what have incorrectly been called "totem-poles" and perches (we find similar insignia borne in the boats painted on the prehistoric pottery), and the earlier method of burial; to the northern invaders the gods in human form (we find the two elements side by side later when a human-headed god has his animal incarnation beside him), especially the god Osiris who certainly came with more highly developed agriculture from Syria (he was primarily a corn-god, and only connected with the dead by identification with the old indigenous deity of the necropoles [*see* CHRONOLOGY]) and the political institutions of the kingdom; while the Libyans contributed peculiar elements of their own. By the time of the foundation of the kingdom the fusion of the two chief races had progressed far and it was probably to a royal house of the invading stock long settled in Upper Egypt that the conquest of the North was due which laid the foundation of the united kingdom of the North and South which persisted in spite of periodical fallings apart, until the end (see *History*).

In all probability the coming of the northerners modified the language (which seems to be a mixture of "Semitic" and Nilotic elements) and they probably introduced a primitive picture-writing of their own (equally the original of the Sumerian script from which in Mesopotamia cuneiform developed), which started the development of the Egyptian hieroglyphic system. This also certainly included a large Nilotic element derived from the natives.

The Archaic P[illegible] The true position of the pre-dynastic culture is exemplified at Naqada and Ballas in Upper Egypt as revealed by the acumen of Jacques de Morgan and recent finds by Petrie and Miss Caton Thompson at Badari and in the Fayum have revealed its earliest phase and a peculiar form of it The transition period from the pre-dynastic period to the 1st Dynasty has been specially illuminated by the work of Reisner at Nag 'ed-Dair, north of Abydos and of Junker at Turra near Cairo The civilization of the 1st Dynasty was revealed to us largely by the discoveries at Abydos in the south and Tarkhan in the north and at Hierakonpolis in the south, due chiefly to Petrie and to Quibell and Green. It is an archaic form of the historic Egyptian culture; its art was still in an archaic stage. Then suddenly at the time of the 3rd Dynasty, under the kings Kha'sekhemui and Zoser, civilization took a sudden upward spring, probably due to a genius, Yemhatpe or Imhotep, the king's minister (*see* below). To this man seems to be due the sudden rise of Egyptian architecture at this time, when we see at Sakkara Firth's fine discovery of the funerary temple of Zoser set around the first Egyptian pyramid, the Step Pyramid of Sakkara. And from this building (*c.* 3000 B.C.) in less than two centuries developed first the pyramid of Snefru at Meidum and then the wonderful Great Pyramid of Gizeh, the grave of king Khufu or Cheops of the 4th Dynasty, itself. The brain-power to which the Great Pyramid testifies is as great as that of any modern man. Under the 5th Dynasty at Abusir the fixed conventions of Egyptian art in temple-decoration first appear. Henceforward for nearly three thousand years these conventions remain the same. A Roman emperor in his guise as Pharaoh appears before the gods in much the same costume as a king of the 5th Dynasty. And the gods never altered. This was the time when the final choice was made of the historic characteristics of Egyptian culture and art, when certain archaic ideas and motives were thrown out and never reappear

Later Development.—Henceforward in spite of minor differences and alterations, chiefly due to foreign invasion or influence things Egyptian remained on the whole the same: there is less difference between the civilization of the 5th and 6th Dynasties and that of the 18th than there is between it and that of the 1st It is a mistake, however, to regard Egyptian externals as absolutely unalterable. Costume changed, for instance, from age to age, though less, probably, than in many other lands. But whereas the costume of kings and gods under the 5th Dynasty is what was actually worn then, the Roman Pharaoh wears this 5th Dynasty costume which no Egyptian king had really worn, except perhaps at religious festivals, since the time of the 12th Dynasty The bewigged and beskirted and be-earringed noble of the 19th Dynasty is very different from his simpler forbear of the 12th And though the Saite noble of the 26th represented himself, by an archaistic fashion, as wearing 5th or 12th Dynasty costume, he certainly never did, any more than our grandees of the 17th and 18th centuries ever donned the Roman armour they are depicted wearing in their statues. And the small things altered continually, the ornaments, the pottery, the stone vases. But this alteration was only unchecked in things with which religion had nothing to do. And these were comparatively few. For in few countries has religion more dominated the art and handicraft of a country than in Egypt. And religious things could not alter. So that the numberless religious objects that entered into the art-repertory of Egypt, the god-figures, the sacred animals, the amulets, etc., maintained a conservative unity in art motives throughout her pagan history, on which the changes were rung in an endless succession Only one man tried to break the spell, Ikhnaton, the heretic, and he failed. To a resuscitated man of the 5th Dynasty the art of the 19th Dynasty, florid, baroque though it was, and filled with foreign ideas from the Semitic East, would still, in spite of differences, have seemed to be the Egyptian art of his own time, of his own contemporaries. He would have found the hieroglyphic writing of the 19th Dynasty, and specially its hieratic, very different, and hard to understand. That is true, but though the combinations were different from that of the Old Kingdom, and many new signs and words had appeared, yet all the old signs were there; it was still the same system. (*See* LANGUAGE and HIEROGLYPHS)

Foreign Influence.—Under the 15th Dynasty we find the first real differences from the classical civilization of the Old and Middle Kingdoms, owing to the conquest of the country by Semitic foreigners, the Hyksos, and the conquest of Hither Asia by the Egyptians that followed their expulsion. This event modified Egyptian culture profoundly, and sowed the seeds of its degeneration. The foreign influences, Asiatic, Cretan, Libyan, grew ever more potent to affect the externals of Egyptian culture, touch the religion (except during the ephemeral revolution of Ikhnaton), and the writing maintained their characteristic form, and preserved the individual nationality of the people.

Archaism, the Last Phase.—Under the Saites, mental revolt against the foreign elements, and against Asiatic contamination generally, combined with antiquarian interest in their own most ancient monuments at Memphis and its neighbourhood, brought about the archaistic movement that sought to imitate the old classical period, and more especially its earlier phase, that of the pyramid-builders. There was a definite archaistic revival in art, but its neo-classicism hardly deceives us. It is always an inaccurate imitation: the scientific archaeologist of to-day was yet unknown. Still, the *effect* is often beautiful, and is eminently characteristic. And the archaism went much further than the realm of art. It did not, however, save Egypt, which went down before the Persian; and when the Macedonians established a new Egyptian empire in Asia, a new imperialist archaism set in, which strove to imitate the works of the Thutmosids and the Ramessides, the imperial style of the 18th and 19th Dynasties, but with less success than the Saite archaizers. The spirit of Egypt was going; she was dying. The Egyptian culture of the Roman epoch was but a miserable parody.

Modern Critical Study.—So archaeological study has taught us to distinguish the characteristics of the successive ages of Egyptian history, to trace its development from age to age. Although Egyptological knowledge without archaeological study, based on excavation, could enable us to possess a superficial knowledge of the process, it is only within the last thirty years that, thanks to modern archaeology, we have been able to pursue our study into minute details. The comparison of the numberless records of scientific observation in excavation has now enabled us to do this, and we can now date objects of Egyptian culture to their proper periods without any royal inscription to help us. It is cumulative evidence that has told. And in the case of Egypt we can do so with more certainty than in the case of any other ancient people, the Greeks not excluded. With one characteristic exception, the figures of the gods. Here we can rarely tell the date of, say, a bronze Osiris, unless he is inscribed or we know with what objects he was found. The gods did not alter. And the dress of the kings was in early days nearly as immutable. But under the 18th Dynasty they had begun to wear a headdress unknown before, and under the 19th Dynasty they begin to be represented in the clothes they really wore, as well as in their hieratic 5th Dynasty costume. But to tell the date of an uninscribed royal figure of the "classical" time is difficult, unless we are well versed in niceties of artistic criticism, which in the case of Egypt has nowadays made great strides, so that the critic can argue that an Egyptian statue must or cannot be of the 12th Dynasty on grounds of style alone, and often with success and accuracy.

3. History of Egyptian Art: the Pre-dynastic Period.—The beginnings of Egyptian art antedate the arrival of the "Dynastic Egyptians" from the north. We see them in the curious painted pottery figures of mourning women, standing or seated on the ground with their arms raised, and with their bodies decorated apparently with tattoo-marks, which are found in early pre-dynastic graves (a fine collection is in the British museum); in tusks of ivory with carved heads of long-bearded men; in a few crude scratched representations of animals on the early red and black pottery, and in the geometric and (rarely) animal-figure designs in thick white slip-paint on red ware. Combs of ivory with male heads, and figures of animals follow, and slate palettes in the form of animals, such as hippopotami, hyenas, bulls, fish and cuttle-fish, on which face-paint was ground for use. Then come the pictures of men, women, goats, cattle and boats in thin red paint on the buff ware. These figures are not in outline and cross-hatched, as in the earlier white and red ware, but are solid. Male figures are rarer than female. The men are naked. The representations of boats are very curious, and with one or two exceptions are extremely unlike boats, so much so that they were formerly often taken to be pictures of stockaded village-settlements, the oars being the stockade, the cabins the houses, while the "totem-poles" with figures of animals would be appropriate to both conceptions. It seems, however, that we must regard them as boats. Then come the first wall-paintings with very similar scenes, as at al-Kab, in which we find the men wearing now the characteristic Egyptian waist-clout of white linen. The colours used are red, white and black. To this time probably belong the rude gigantic figures of the god Min from Keptos, in the Ashmolean museum, with their reliefs of goats on hills.

As the conquest by the people of the North continues we find the level of art rising swiftly. The flint weapons are at their finest, the technique of stone-vase making rapidly improves, gold decoration begins to be used, as for instance on the handle of the famous flint knife from al-'Araq. But pottery deteriorates. It would look as if the improvement in stone vessels meant less interest in the finer kinds of pottery. Stone and gold-work attract most attention. Stone sculpture begins in rude flat relief figures on limestone grave stelae. A parallel with contemporary Sumerian art is found in the sculpture of processions of animals, generally sheep, goats or cattle, no doubt these were intended to ensure continuance of riches in flocks and herds in the next world. The slate paint-palettes develop into large objects with a circular ring-depression for the paint, and are decorated with most lively scenes in low relief of hunters, armed with bows and arrows and throwsticks pursuing lions, and of the corpses of the dead in battle being cast out to be devoured by vultures (British museum, Louvre). Other such fragments show ostriches (Brit. mus.) giraffes with a palm tree (Ashmolean); on another (Brit. mus.) is the earliest hieroglyph known, the symbol of the god Min, while on the British museum fragment of the large "hunt-palette" is the hieroglyph of a chest, the sign of "burial."

The Archaic Period.—These works herald the beginning of the Dynastic Period, when we find a strongly marked upswing of artistic capacity. Progress is specially marked during the first five reigns, of Narmerza and 'Ahai (who with the pre-dynastic Southern king and first conqueror of the North were probably together the originals of the legendary "Menes"), of Zer, Za and Den. We know the work of this time well from the discoveries at Abydos, Hierakonpolis, Tarkhan and Turra. A typical example of this progress is seen in the one instance of the figure of the hawk, typifying the king, above the *serekh* or "proclaimer" banner containing the name of the king, now written in genuine hieroglyphics which we can interpret. This hawk-figure develops in a most interesting way, till after the end of the reign of Den it takes on its characteristic form, which it has finally assumed by the end of the dynasty. And in order to appreciate not only the advance that was made during the early dynasties, but also the remarkable strength of conception and power of design in the work of the beginning of the 1st Dynasty we may compare reliefs of the 3rd and 4th Dynasties with the *chef-d'oeuvre* of the archaic period, the remarkable slate "palette" of Narmerza from Hierakonpolis (Cairo museum; casts in British museum and at the Ashmolean), on which we see in relief "Menes" attended by his sandal-bearer, inspecting the bodies of his slain Northern enemies, while the hawk of his Upper Egyptian tribal god Horus seizes a strange half-human figure emblematic of the North above, the queer fetish-heads of the cow-goddess Hathor, which we already know in the pre-dynastic period, seem to typify the union of the two races that was producing Egyptian civilization. The great ceremonial mace-heads of the Scorpion and Narmerza also from Hierakonpolis (in the Ashmolean), commemorating the Scorpion's conquest of the North and the Jubilee festival of Narmerza also show very interesting reliefs. "One is struck by the narve energy of this commemorative art which has preserved

for us a contemporary record of the founding of the Egyptian kingdom." In ivory we have (Brit. mus.) the extraordinarily lifelike little figure of a king (No. 37,996) wearing the crown of Upper Egypt and a long and very foreign-looking patterned robe of a kind that we never see a king wearing later, which was found by Petrie at Abydos. It is probably the most precious relic of the archaic period.

Den-Semti was the first to bear the afterwards time-honoured title of "Insibya" or king of Upper and Lower Egypt, and in his time the first moment of crystallization in the development of art and culture occurred. After his time the *tempo* slows down; originality becomes rarer, crudities begin to be thrown aside. At the same time luxury increases noticeably. From the relics found in his tomb, or cenotaph, at Abydos we see already a rich and picturesque civilization, energetic and full of new ideas, both artistic and of a more practical character. Gold and ivory and valuable wood were lavishly used for small objects of art, fine vases of stone were made, and the wine of the grape (*irp*) was kept in great pottery vases stored in magazines like those of the pithoi at Knossos. The art of making the blue glaze "fayence," that typically Egyptian art, which had already been invented in pre-dynastic times, developed very much at this time. The king's jewellers made wonderful bracelets of gold and carnelian, sceptres of sard and of gold, and so forth. The king's carpenters "could make furniture of elaborate type; the well-known bull's hoof *motif* for chair-legs already appears." And they could make the interesting little labels of ivory and wood on which were inscribed the events of the king's reign, with incised representations of him smiting his enemies (Brit. mus.) Wood was imported for large and small work, for beams or for year-labels, into woodless Egypt from Syria already, no doubt by sea. It was used considerably in building in conjunction with brick, for the art of stone building had not developed much yet; that progress was reserved for the next age. Pottery had deteriorated badly since the pre-dynastic age. It is a curious fact that elsewhere, in Babylonia and in Crete, for instance, the pottery also degenerated at the opening of the age of metal. It was still built up, made without the wheel, which had not yet reached Egypt from Babylonia.

Possible Babylonian Influence.—The question of Babylonian influence on the nascent Egyptian culture and art is interesting and important. We see undoubted traces of it in many things, chief among them the style of building brick walls, which are simple reproduction of the Sumerian style, with its recessed panels, in everything but the shape of the brick, which in Egypt is always rectangular and long, never either plano-convex or a flat square, as often in Babylonia. It looks as if the crude brick had been invented independently in Egypt, as it naturally might be in a land of mud, but that the panelled style of building with bricks came from Babylonia. Again, the use of stone (and wood) seal-cylinders at this time in Egypt, and also of the peculiar conical macehead, points to Babylonian influence. A reverse influence, of Egypt on Babylonia, is improbable, because in Babylonia at least the first of these things were at home, and were there to stay, whereas in Egypt they were not destined to last, the use of the seal-cylinder indeed being comparatively ephemeral there. Then there are the Babylonish-looking monsters on slate palettes, which disappeared from Egypt with the 1st Dynasty, the similar processions of animals in both arts at this time (already mentioned), and the identical early representation of the lion with open grinning jaws and round muzzle in both countries; already by the time of the 3rd Dynasty the Egyptian had dropped him and evolved his own dignified lion with closed mouth, whereas the Babylonian retained his own furious lion to the end of the chapter of his art. These things, and others, are important to note, especially now that we seem to be compelled by the latest discoveries at Ur to recognize the superior antiquity of Sumerian art. If Babylonia was the senior we could understand that she contributed something to the feverishly accumulating make-up of the young Egyptian culture, some of which was afterwards dropped. But there is the question whether the communication was direct or whether the fact was that both Egypt and Babylonia received certain similar elements of culture from a common source, which must have been in Syria. We do not yet know. The "dynastic Egyptian" who came from Syria probably brought certain elements of culture thence; besides developed agriculture and the connected Osiris-Isis worship, also probably the knowledge of copper, and probably the conical macehead and possibly the panelled style of building. But other foreign elements seem later, and to be contemporary with the union of the kingdom; and it must be remembered not only that more or less direct communication with Babylonia through the Hauran and so across the desert was then possible as later, but that in all probability direct sea-communication existed between such ports as Qusair, at the sea-end of the Wadi Hamamat, and the ports of Southern Babylonia. The evidence of the al-'Araq knife with its gold-beaten handle-reliefs of foreign ships and a Babylonish-looking god is evidence of this even in the pre-dynastic period; and we know that in all probability the Magan, "the place to which one goes in ships," from which the Sumerians derived some of their hard stone (unobtainable in their own country) was the Eastern Desert of Egypt and possibly Sinai.

However this may be, the two cultures very soon took each its own line of development, and Babylonia, at least, was never influenced in the smallest degree by Egypt except possibly at one single period, that of the Sargonide kings of Akkad (*c.* 2700 B.C.) when a peculiar style of sculpture was in use that recalls the work of the early Egyptian dynasties more than anything else in technique, though the subjects show no sign of Egyptian influence.

The Epoch of Imhotep.—Under the long 2nd Dynasty we have little to record; a static period succeeded the dynamic 1st Dynasty. But with the advent of the short-lived 3rd, a new dynamic period set in suddenly with a political explosion. A new king from the South Kha'sekhem, dispossessed the successors of Menes, who had taken up their abode in the conquered North, and as king of both countries called himself Kha'sekhemui ("Appearance of the two Powers" instead of "Appearance of the Power") His statue in the Ashmolean Museum, from Hierakonpolis, tells us that he took 47,209 Northerners captive, and on its base we see summarily cut in outline, variously contorted figures of the slain. Evidently the twisted attitudes of their bodies were admired and sketched at the time, and were reproduced by the king's sculpture on his statue-base. "It was an age of cheerful savage energy like most times when kingdoms and peoples are in the making." The statue of the new Menes however did not mark a very great advance on former work, though it was bigger; the lifesize figure was to come in the next reign, which marked a climacteric in the history of Egyptian art and science. His son Zoser (Tosorthros) was probably one of the greatest of the early pharaohs; at any rate he was served by one of the greatest of Egyptian ministers, the wise Yemhatpe or Imhotep, who was later deified under his own name (in Ptolemaic days pronounced Imouth, the Imouthes of the Greeks), as the god of knowledge and especially of medical science the Egyptian Asklepios. He is depicted as a priestly man, seated, reading a scroll open on his knees. Imhotep was not only a physician, he was also an architect, and it is more than probable that the extraordinary architectural development that marks the reign of Zoser was due to his inspiration and teaching. He was certainly not deified for nothing, and when we find that it was in the reign of the king whose minister he, the divine patron of science, was, that a sudden and unparalleled advance in art and architecture was made, we can hardly err in attributing this advance to him. It was always recorded that it was in the reign of Tosorthros that "the first stone house was built," as we read in Manetho; and the most ancient Egyptian pyramid, the "Step-Pyramid" at Sakkarah, was built by Zoser. No such great stone building was known before. And now Mr. Firth has revealed at Sakkarah the original 3rd Dynasty funerary temple of the king, with the *serdab*, or recess, in which his lifesize statue (the oldest) was placed at his death and found by Mr. Firth; and it is more than likely that the royal tomb itself may be reached. And the most extraordinary thing about this temple is its architecture. It has panelled walls of fine limestone, and lotus-columns of the same beautiful oolite stone; long corridors of them: the work is the first

[illegible] pre[illegible] [illegible] But [illegible] here seems [illegible] for any such development. In the work of the 1st Dynasty there was nothing like this. The conclusion seems unavoidable that this was a sudden development due to a single brain, that of the wise Imhotep, or to two brains, if Zoser is to be given a share of the credit. And such sudden developments do occur from time to time in history: such powerful brains do sometimes appear, and bend things to their superior will. We have later instances in the history of Egypt itself, notably that of Ikhnaton, though his work was impermanent. We are too apt to assume "long periods of development." Nature does not do things *per saltum* but man does. He sometimes creates specially, as Imhotep seems to have done. At any rate, in the absence of any evidence of any such previous development, we seem justified in assuming so.

It was not only in architecture that the creative genius, whom we have supposed to have been Imhotep, showed his hand. In relief sculpture also the style that had already appeared in the memorials of the 1st and 2nd Dynasty kings on the rocks of Sinai now developed into the first examples of the historic Egyptian style, with the king depicted in the manner in which we see him henceforward; though it was not stereotyped till the time of the 5th Dynasty. Sculpture in the round remains more archaic in type, with curious human faces reminding us of certain extraordinary sculptured heads hitherto usually attributed either to the Hyksos or to the 9th Dynasty (at Cairo), which may however themselves be of the 3rd. The portrait-statue of Zoser is somewhat of this type, and the figure is distinctly archaic still. Sculpture in the round was not to take its final form till the next dynasty, the age of the great pyramid-builders.

The Pyramid-builders.—The impulse given to architectural development in Zoser's reign pushed on swiftly in less than a century after his death to the achievement of the most colossal buildings in Egyptian, if not in all human history, the Great and Second Pyramids of Gizeh, the tombs of the kings Khufu (Cheops) and Khafre' (Chephren) of the 4th Dynasty. The wonderful height attained in the sphere of mathematics and engineering, as well as design, which is attested by these two great buildings, has always struck the imagination of mankind.

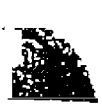
At this time begins the long series of private tombs decorated with reliefs representing the dead owner amid his daily surroundings, with his wife and family, hunting or overseeing his estates, and with his fellahin engaged in their daily avocations. The royal tombs themselves are not yet decorated in any way, but their funerary temples, close by, were, chiefly with religious scenes. At the same time sculpture in the round assumes its final form in the statues of the kings Khafre' and Menkaure', the latter with his queen and with the goddesses of the "nomes" or provinces of Egypt, which are among the greatest treasures of the Cairo museum. We now see in the faces of the kings the first examples of the Egyptian genius for personal portraiture which later became one of the chief and most valuable characteristics of Egyptian art. Another portrait-figure of the time is the well-known "Sheikh al-balad." And in the famous statues of the Prince Ra'hotep and his wife Nefert (also at Cairo), with the amazing lifelike effect of their eyes, produced by the means of a pin of copper representing the iris inserted into a crystal eyeball, we have a startling combination of accurate portraiture and appearance of life. This technique of eye-representation was often repeated in Egypt later on, in glass or obsidian, as well as crystal. It was paralleled contemporaneously in Babylonia, by means of shell for the white of the eye and jasper for the cornea, but not so successfully. Wood-carving is exemplified in the beautiful reliefs of the panels of Hesire' at Cairo. Pottery improves, a fine bright red polished ware coming into use, that continued till the time of the 7th Dynasty.

Under the 6th Dynasty the pyramids deteriorate, and are largely [illegible] of limestone, whereas [illegible] had been made of the [illegible]. The actual tomb-chamber of [illegible] with religious texts, the "Pyramid Texts," [illegible] the next world calcu[illegible] the [illegible] of the dead monarch there, precursors of [illegible] from the Book of the Dead of a later epoch (see *Religion*). The funerary temples on the other hand are magnificent, built with great papyrus-columns of red granite and decorated with fine reliefs in which the official religious style is now fixed. Tomb-reliefs and portrait-statues continue excellent. Stone vases have become smaller and more delicate; under the 5th and 6th Dynasties beautiful unguent pots of alabaster (calcite) were often placed in the tombs.

Under the 6th Dynasty we have the magnificent statues from Hierakonpolis of king Pepi I. and his small son in copper (not bronze, as used to be thought owing to a mistaken analysis), at Cairo. The copper was apparently beaten, not cast, though this is not quite certain in the case of the head of the prince. Here we have a technique that first comes to our knowledge now, though it was probably older, since we have a record of a copper statue having been made of king Kha'sekhemui under the 3rd Dynasty. It is probable that this art came to Egypt from Babylonia, where we find it in the case of the great copper reliefs and figures of animals found at al-'Ubaid, near Ur, which date to about 3100 B.C., and are presumably contemporary with the 3rd Dynasty owing to the usual computation, but before the 1st if we adopt that of Scharff.

The Middle Kingdom: 9th to 12th Dynasty.—At the end of the dynasty, art, which had been slowly deteriorating for some time, temporarily disappeared in a welter of civil war and possibly foreign invasion, both of Semites from the North and Nubians from the South. Under the Herakleopolite kings of the 9th Dynasty it reappears, but under the first Thebans of the 11th is still of a rude and clumsy character, especially in its reliefs, until in the settled and prosperous reign of king Mentuhotep III., who reunified the distracted country, a sculptor seems to have arisen, named Mertisen, to whom is probably due the artistic renascence of the Middle Kingdom. His work is to be seen in the sculptures of the king's funerary temple, Ikh-isut, at Dair al-bahri, discovered by Naville and Hall in 1903 (Brit. mus.). These reliefs and figures are still a little crude, but give ample promise of the fine art to come. In the reign of Amenemhet I., the first king of the 12th Dynasty, we find a very delicate style of relief. Under Senusret I. sunk relief (*cavo rilievo*) is used at Koptos, in that of Senusret III. (Sesostris) splendid vigour of portraiture in the grey granite royal statues from Dair al-bahri and the red granite head from Abydos (Brit. mus.), which becomes magnificence in the famous portraits of Amenemhet III., especially in the small obsidian head, formerly in the Macgregor collection, which is probably he, and is a marvel of style and workmanship in so intractable a material as well as, evidently, a faithful portrait of the original. Another small portrait, in serpentine, which is certainly Amenemhet, was in the Grenfell collection, and now belongs to Mr. Oscar Raphael. The small statue of him as a young man, at Leningrad, is also well known (casts of all three in the Brit. mus.). A sphinx now in the British museum, recently presented by the National Art Collections Fund, magnificently carved, shows us the hitherto unknown features of his son Amenemhet IV. The treatment of the mane of this sphinx, in short lion's locks, is precisely similar to that of the manes of the so-called Hyksos sphinxes from Tanis at Cairo which are, on this new authority, definitely to be dated to this period and no doubt present portraits of Amenemhet III. Tomb reliefs now are uncommon, and the wall decoration is usually simply painted in tempera.

The small arts of ivory carving, of fayence-making, of gold and electrum work, and of *cloisonné* inlay in beautiful stones such as carnelian, lapis, turquoise and blue felspar, of scarab-making in glazed steatite, obsidian, crystal and amethyst, are all now at their apogee. Nothing so tasteful, so well proportioned, so graceful, so delicate was made later. The figures of the royal princesses from Dashur and Lisht are of beautiful workmanship. Scarabs at this time came into general vogue. They had been used at the end of the Old Kingdom and made of blue glaze, without inscription, but with the labyrinthine designs common at the time on small seals, especially on a class known as "button-seals," probably of foreign origin, and usually made of ivory or steatite, which is



closely paralleled in early Minoan Crete. From the 9th to the 12th Dynasty the scarab develops with characteristic spiral designs of Aegean (and possibly ultimately Central-European) origin, and under the 12th inscriptions are added; it begins to be used as a seal. When inscribed its material was usually of glazed steatite; scarabs of the harder stones were generally not themselves inscribed, but often bore an inscription on a gold, electrum or silver plate cemented to the base. Twelfth Dynasty scarabs are among the finest known, both for design and beauty of glaze (*see* also SCARAB).

A quaint, often crude, but also often finely executed art of the period from the 6th to the 12th Dynasty, is the making of the little model figures of people at work in the fields or the granaries, ploughing, winnowing, etc., also of boats with their rowers, conveying the funeral cortege across the Nile, which were placed in the tombs at this time. (See *Religion*)

Ivory carving was a specialty of this dynasty, very characteristic being small seated male figures, like the wooden ones, often with inscriptions or spiral designs on the base. Small figures of this kind were characteristic of the time also in other materials, especially blue fayence; and magnificent small examples of figures of animals in this material, especially of hippopotami, with the water plants amid which they lived, painted in manganese black on their sides, are in the chief museums. The fayence has now largely abandoned the original pale blue colour of the Old Kingdom for a splendid deep blue. Ordinary pottery has now deteriorated again, the fine polished red ware of the Old Kingdom disappearing. Stone vases continue to be fine, especially those of alabaster and of a peculiar blue marble very popular at this time for unguent-vases or *alabastra*.

Thirteenth Dynasty Art and Hyksos.—Under the 13th Dynasty deterioration again set in. The great school of sculptors cannot keep up the standard of Amenemhet III.'s time. Royal statues become curiously lanky and attenuated; faces and necks get long, heads disproportionately small, as in the Sebekhotep in the Louvre. The finest work of the time (early in the dynasty) is the head long attributed to Amenemhet III. (and formerly to Apepi of Hyksos) from Bubastis in the British museum. From the form of the headdress and other characteristics I would attribute this work to the 13th rather than the 12th Dynasty. The king whose portrait it is is unknown. But things never get so bad as they were between the 6th and 9th–12th Dynasties. The 12th Dynasty taste in small objects continues, though workmanship falls short of the old distinction. A newly developed art is that of coffin-decoration. Until now the dead had been placed in great rectangular chests, at first with little ornament but a bare inscription, then under the 12th Dynasty finely and simply decorated without with bands of inscription, and often within with maps of the underworld to guide the soul, pictured lists of the amulets and sacred unguents buried with him, and funerary spells of power. In this under the 12th Dynasty the mummy was often placed with a human-face cartonnage mask over its head. In the following period the rectangular chest was given up (probably owing to growing difficulties of obtaining suitable wood from Syria) and an outer coffin of poor native wood was substituted with a human head like that of the inner mask, and with body roughly shaped like a swathed mummy. In the case of some of the kings the body of the coffin was painted with the vulture-feathers of the protecting goddess, so that they are known, from the Arabic word, as *rishi* coffins. Henceforward the human-headed coffin was the rule (see *Religion*), and an enormous number of artists (of high and low degree of capacity) must have been employed at all times in making, painting and gilding them.

The New Kingdom: 18th Dynasty.—Under the 18th Dynasty a new renascence begins, with a new note of a hitherto unknown tone. A wave of Asiatic conquest had overflowed Egypt, and had retreated, but it had left its marks. The art of the first two reigns of the new dynasty of "Liberators" bears strong traces of close relationship to that of the 12th–13th Dynasties, but in the reign of Thutmosis I., the first to carry the Egyptian arms into Syria to avenge the Hyksos conquest, the new element appears which is [illegible]ly due to f[illegible] Syrian infl[illegible] Such things as the chariot (*see* below) were directly adopted from Asia with the advent of the horse and weapons add to their number such a purely Asiatic form as the curved scimitar or *Khepesh*, previously unknown, and certainly adopted, like the chariot, from the Hyksos. In the reign of the conqueror Thutmosis III. we are in the full tide of the great civilization and art of the 18th Dynasty, and we see in it unequivocal traces of the foreign influence, which increases as time goes on. In the reign of Amenhotep III. it is specially strong, but at the same time in no way dominant or able in reality to denationalize Egyptian culture and art at all. The old Egyptian traits, especially in the all-embracing domain of religion, are as strong as ever. But where religion could not penetrate, the loss of character due to foreign connections is evident. The new art, like the new culture, is beautiful, but it is lavish, its taste is not so good as was that of the 12th Dynasty, it is rococo

In architecture we do not see any very great development of previous ideas. We know very little of the temple-buildings of the 12th Dynasty, as they were mostly rebuilt in later days, but it is probable that the 18th Dynasty introduced few new improvements on them. Even so original a building as Queen Hatshepsut's terrace-temple at Dair al-bahri is now known to be merely an enlarged adaptation of the older temple of the 11th Dynasty at the side of which it was built. The old tradition of adorning them with the statues of the kings who built them is carried on, with the same care of portraiture, and with a greatly developed tendency to gigantism, which began under the 13th Dynasty when the first colossi were produced. The colossal head of Amenhotep III. in the British museum is one of the finest Egyptian portraits existing. The extremely unbeautiful, but probably lifelike, colossal heads of Ikhnaton, lately discovered, are evidence that the colossus-convention was retained by him. Among smaller royal portraits the young Thutmosis III. at Cairo is one of the finest known; it is unusually unconventional in treatment for the time, and no doubt a good likeness. A more conventional head, probably of the same king (but by some considered to be more probably his sister Hatshepsut) in the British museum, shows how the royal features could be toned down and regularized for an official portrait. Votive statues of private persons show the same regularized portraits, but very often they are as true as under the 12th Dynasty, as we see from the famous figures of the sage minister, Amenhotep son of Hapu, at Cairo The groups in white limestone of a man and his wife seated, side by side, which were either placed in the round in tombs or sculptured in high relief in the rock at the end of the tomb-corridor, are very characteristic, and show the costume of the new age with careful accuracy. For costume had now altered and developed in a way unknown since the beginning of the Old Kingdom, though the change was in no way so radical as those known in Europe. There was, however, now an added note of grace in men's as well as women's costume, that contrasts greatly with the stiffness of the dress of the older dynasties (see *Dress*) Tomb-decoration for private persons of distinction consists chiefly of wall-portraits in distemper depicting the same scenes of daily life as before, to which great men add pictorial records of the honours they have received from the king, or of events of their time redounding to the honour and glory of their royal master, such as the reception of foreign ambassadors and tribute-bearers from Asia and from Greece. The tomb of Sennemut, the architect of Queen Hatshepsut, of Rekhmire', the vizier of Thutmosis III., and of Menkheperre'senb, another great man of his time, are cases in point. In them we see pictures of the reception of Minoan ambassadors from Crete which are among the most important historical records of their time. In the reign of Amenhotep III relief decoration comes into fashion again for tombs, as it had always been used in the temples. The delicate colour reliefs of the temple at Dair al-bahri, depicting Queen Hatshepsut's expedition to the land of Punt (Somaliland) are among the finest earlier works of the dynasty. Later on we have such fine work as that in the tombs of Khaemhe't and Ra'mose at Thebes. The royal tombs do not yet show the elaborate painted decoration, repre[illegible] scenes in the next world, so characteristic of the 19th

[illegible] Tutankhamun's tomb is but a sepulchre, with little wall-decoration and that unfinished.

The actual objects buried with the king are of unparalleled magnificence. In his case not only specifically funerary objects were buried with him but also, apparently, most of the things that he had actually used in life, his chairs, clothes, boxes, lamps, chariots, sticks, weapons, rings, amulets, necklaces, etc., and it is probable that much the same thing was done in the case of every deceased monarch. But only Tutankhamun's has ever been found intact, though we have previously found objects, fewer in number, but of almost equal magnificence and interest, in the tomb of Iuya and Tuya, the grandparents of King Ikhnaton whose successor Tutankhamun was. These things enable us to form a picture of court life in the fourteenth century B.C. in Egypt more complete than that which we possess in the case of any other ancient civilization. Archaeological excavation has told us more of ancient Egyptian life than that of any other ancient nation. For details of the various wonders of ancient art that Tutankhamun's tomb has revealed the published accounts of this find must be consulted. But little has been revealed by it that was actually unknown before. The forms, the motives, the types of decoration were all known. But we often find them in new and unprecedented combinations, especially in the royal jewellery, which shows how sumptuously the old 12th Dynasty tradition of gold and semi-precious stone inlay was carried on. The taste, however, is now not so good. The newer art is sometimes rather garish and vulgar, as seen in many other objects from Tutankhamun's tomb such as, more especially, the great alabaster or calcite vases represented as on imitation wooden stands of alabaster and combined with the twining papyrus and lily-stems emblematic of South and North; the conception is forced and ugly. Calcite vases with coloured lions on their lids look as if they were made of sugar and were intended to be eaten. Bad taste is beginning to creep in. But on the other hand we also see the characteristics of the new free conception of art introduced by Amenhotep III. and Ikhnaton in the representations of the young king with his consort on the back of a chair, or the almost Persian miniature picture of a lion-hunt on a box. Foreign influence we see too in such work as that of the king's iron and gold daggers, with their non-Egyptian type of hilt and gold filigree decoration.

The Amarna Period.—In the reign of Amenhotep III. a new impulse towards freedom in art was given, in conjunction with the movement towards new thought in religious matters, which culminated in the monotheistic cult of the *Aton* or sun-disc, proclaimed by his son Ikhnaton (see *Religion*). For a time Egyptian art seemed to be about to cast off its age-long shackles, and, had the religion of the Aton endured, this would have happened. The removal of the religious bonds would have led, probably, to an extraordinary development of art, and at the same time have altered the whole course of Egyptian civilization. But this was not to be; and after only a few years, in the reign of Tutankhamun, in fact, king and people returned to polytheistic orthodoxy, and history resumed its course on the old lines. It was in fact impossible to alter the religion of the whole nation, and we see that in spite of all his efforts, Ikhnaton was unable to detect the Egyptian mind more than a very little out of its accustomed ways. In the art of his time, of which we have recovered so many magnificent examples from the ruins of his city of palaces at el-'Amarna, the old motives of religious origin still persisted. There is nothing radically new in the most daring innovations of the disc worshippers; only the representation of the sun-god himself, as a disc with rays terminating in hands holding the symbol of life, is entirely new. The old *clichés* go on in use, and after all they were beautiful, extraordinarily decorative. They were preserved. In sculpture in the round we see the new striving after truth in such a wonderful portrait as the coloured stone head of Queen Nefertiti at Berlin, in which all ancient convention seems to have been dropped: even the eyes are painted naturalistically, with most of that curious antique convention of representation that had persisted since the days of the 1st Dynasty and was to assert itself very soon. Of the sculptor's desire for truth we have a proof in the extraordinary series of plaster masks, taken from living and dead faces, and from statues, found with the Nefertiti head in the "House of the Sculptor" at Amarna. They were part of his stock-in-trade to be used for portrait-figures. We see new ideas in the representation of the home-life of the royal family, shown with a freedom unprecedented; for the first time Egyptian royalties are human. Ikhnaton offers his wife a flower Amenhotep III. leans forward heavily and lazily, arm over knees, as he sits on his throne, even in a formal sculpture; Tutankhamun and his wife are shown affectionately conversing. But the setting remains the same and the technique cannot alter, and above all Ikhnaton cannot change the hieroglyphic writing, in which the whole ancient history of Egypt's religion and art are enshrined. The protest could not last; and when the priests of Amon gained the upper hand, after the king's death, it was not long before all the ephemeral beauty of Ikhnaton's art disappeared. Tutankhamun's tomb had a few things of his style; after all, he had only been a few years dead. But after the long reign of the conservative reactionary Horemheb nothing remained of the beauty that Amenhotep III. had envisaged and Ikhnaton had for a moment carried into effect, than a certain delicacy of workmanship in the reliefs of Seti I. at Abydos and the swan-song of fine Egyptian art—the beautiful statue of Rameses II. at Turin.

Small art shows the old characteristic of freedom in all things non-religious. Alabaster vases are specially beautiful; the jug-shape, previously unknown, comes into use, and the globular-bodied, high-lipped vase on a high foot. Scarabs alter very much in type, green glaze comes into vogue, fayence becomes a favourite material, and in the first half of the 15th century the blue fayence is extraordinarily beautiful. Later on, under Amenhotep III., polychrome glazes are introduced, and all sorts of vivid shades of blue, violet, yellow, chocolate, apple-green are used, which are characteristic of the Amarna period. This polychromy arose from the new polychromy of glass. Under the 12th Dynasty real glass, as opposed to glaze, appeared for the first time. It was at first plain blue; but about the time of Thutmosis III. the art was discovered of making the wonderful opaque polychrome glass vases that are among the most beautiful and most valuable contents of our Egyptian museums. The first produced were somewhat heavy and coarse, but very soon a remarkable lightness of handling was obtained. A particularly beautiful pale blue is characteristic, and an imitation of obsidian or black glass is excessively rare. Combination of all these materials with gold is common. Gold is lavishly used. "Gold is as dust in thy land, my brother," writes the king of Babylonia to Amenhotep III. Tutankhamun had a solid gold coffin. And no doubt other kings had solid gold coffins also. Gold is used very freely in conjunction with wood, especially in furniture and in chariots. The arts connected with chariot-wheel making and horse-trappings generally are new in Egypt at this time, as the chariot and horses were not introduced from Asia till the time of the Hyksos, about 1800 B.C.; previously the Egyptians had not employed wheeled vehicles at all, but sledges, and asses for draught. Bronze is now in regular use for weapons, and iron comes into more general use but is still precious and worthy of kings.

The Ramessides and the Decadence.—Under the kings of the 19th Dynasty the degeneration sets in. Gold is too much to the fore and is becoming vulgar. Growing vulgarity is the note of the age. The long reign of Rameses II. saw a progressive decline of the arts. We find a grandiose conception of Tutankhamun's architects at Luxor imitated by Seti I. in a still more grandiose conception, the great Hypostyle hall at Karnak. But it is too big; too gigantic. It is coarse and clumsy. And this coarseness is seen in all the arts after the death of Seti. There is only one good statue of Rameses, that at Turin. The rest are either abominable, or else are not really his but are stolen from former kings. The great rock-cut temple of Abu-Simbel is an atrocity, with its great lumpish clumsy figures, everything out of proportion, everything all wrong. The huge royal tombs are imposing with their pictured halls showing the adventures of the soul in

e unde world But the r pa nt ng s often coarsely executed Re no afte Se s low rel ef vork at Abydos, generaly sunk n *rorle-o*, an old Egyptian idea not much in favour under the 18th Dynasty. Now we find it employed for the amazing scenes of royal wars that covered the outer walls and pylons of the temples in which the king, of an enormous size, slays hordes of foreign enemies. He had done this before, on a smaller scale, in art as far back as the time of the 1st Dynasty, but now he did it on the heroic scale. And the style is almost barbaric. Private tombs, excavated as before in the hillsides, show a progressive degeneration of the 18th Dynasty decoration.

In small art vulgarity progresses, but not so blatantly. Many beautiful small things of art were made under the 19th Dynasty, of faience, of alabaster and other stones. The fine alabaster vases of the 18th Dynasty continue, often with handles in the form of animals; but forms deteriorate. The blue faience is not quite so good; polychromy continues in duller, dirtier tints. Red stones come into use, such as jasper, sard and carnelian to the exclusion of blue, though stones of Asiatic origin, like lapis or chalcedony, were rather favoured. Asiatic influence becomes more and more marked; Semitic gods, Semitic names and Semitic ideas appear upon the monuments.

Under the 20th Dynasty the pace of the deterioration increases, especially after the reign of Rameses III. Temples become hideous rows of sausage-pillars with hieroglyphs a yard high, miracles of bad taste. Gold becomes gilding, and it is everywhere; vulgar display hides growing poverty of idea. There is nothing new, there is nothing distinguished now. Tomb reliefs are stereotyped; even the old power of portraiture has gone. Under the 21st there is a short Indian summer of art at Thebes; almost a pathetic attempt at a revival of lost beauty. The blue faience is startlingly deep in colour; something had been recaptured here. But it is too harsh a blue, and the modelling it covers is worthless. The art of coffin-making which had developed in the direction of complexity of religious ornament from the simple inscription bands of the 18th Dynasty is now very elaborate. The yellow-varnished coffin of the time with their relief decorations and inscriptions in gesso, are well known. We have an interesting relic of the time in the embroidered "funeral tent" of Queen Isemkheb, which has been eclipsed as an example of an Egyptian luxury-textile by the robe (?) of woven linen tapestry of Amenhotep II., found in the tomb of his son Thutmosis IV. We know that the Egyptians used embroidered linen in great variety (though little of it has come down to us) from the paintings. The national art of linen-making is of course characteristic of all periods from the pre-dynastic, when it first appears, though it may have been at its finest under the 11th and 12th Dynasties.

The Archaistic Renascence Under the Saites.—With the 22nd Dynasty everything becomes bad, poor and dull; it is the nadir of Egyptian art. Under the 25th however in the North a new spirit arose in the 8th century. The monuments of the pyramid-builders in the vicinity of Memphis attracted the attention of the artists, and a new school of sculptors arose at Memphis characterized by a curious archaism. The style of the ancient statues and reliefs was adopted, often directly imitated. Notables of the new time were shown wearing, not their real clothes, but the plain loin-cloths of the 5th Dynasty, combined with the round wigs they usually wore; just as in the 17th and 18th centuries our worthies were often represented in Roman armour with wigs. Sometimes, as in a statue at the British museum, the archaism extends to the wig, so that but for the inscription it would hardly be possible to tell that the statue was not of the 5th Dynasty. The writing could not be archaized very much, though attempts were made in that direction. At Thebes something of the old imperial art-tradition remained, and there we see a neo-Theban school, with a touch of the Memphite archaism in it, which produced some remarkable work in the 7th century, notably the portrait heads of the princes Nsiptah and Montenhe't and the unknown old man in the British museum (No. 37,383). Here the native genius for portraiture again shines forth after its eclipse since the 20th Dynasty, and throughout the 26th Dynasty it persists, and later, till it again dies out under the Ptolemies. The Saite archaism was eclectic, and we can often diagnose it by its mixture of the characteristics of historically different periods, such as the Pyramid-time and the 12th Dynasty. It appealed to the Egyptians of the seventh century as appropriate to the new course in national history which was now entered on after the emancipation from Assyrian conquest under the Saites. The old imperial order constituted with such splendour under the 18th Dynasty was dead, and men turned for new inspiration to the ancient days of the pyramid-builders, before Asia, taken captive, had corrupted her conquerors and planted in them the seeds of decay. The result in the domain of art, as in other things, was the creation of an artificial simplicity and juvenility which, however, was by no means without beauty. The Saite sculptors were wonderful workers of the hardest stones, and their work in basalt and granite, combining the simplicity of old days with the delicacy and style that was wholly new, is characteristic of their period. In small art we see a conscious return to ancient ideas in the abandonment of the dark blue fayence for an imitation—a most delicate and beautiful imitation—of the pale blue of the Old Kingdom. This pale blue faience, well exemplified in the *ushabti*-figures of the time, so well known in our collections, is characteristic of the time. Scarabs and scaraboids were beautifully made of fine stones; the Saite engraver was a master. But it was not only in small things that the Saite artist excelled. He made very big things too, such as the huge monolithic shrines in the temples, equally characteristic of the period. Tombs were now built very often with a certain archaism, in the form of huge brick buildings above the actual chambers of the dead hollowed out of the rock below; this was in some sort a return to the *mastaba* of the Old Kingdom, and a rejection of the hillside chamber-tombs of the 12th and 18th–20th Dynasties. Tomb reliefs imitate those of the 5th Dynasty, with a difference that does not escape the modern critical eye. And as time goes on we see this difference accentuating itself in a way that we cannot mistake; it is being influenced by the renascent Greek art of the 6th and 5th centuries. Already under Apries and Amasis we see Egyptian figures adopting a curious simpering smile, which we can hardly fail to attribute to the influence of Greek archaic art, communicated through the medium of Naukratis, of Daphnae and of Cyprus. This "archaic smile" which was natural to the young Greek art, was unnatural and artificial in Egypt, and was adopted there merely as a preciosity. It continued all through the Ptolemaic period in Egypt, and became characteristic of the work of that age. Conversely, Egyptian archaistic figures influenced the early Greek sculptors in their figures of Apollos or winners in the games. In the 5th and 4th centuries Egyptian tomb-reliefs and vase-decorations show definite imitations of the new mature Greek art grafted on to the archaistic Saite style. The age of the last native kings is still in its art Saite, but of a curiously delicate refined character to be carefully distinguished from the larger style of the 26th Dynasty.

Ptolemaic Art.—Under the Ptolemies there is another change. Foreign conquest again became familiar under the successors of Alexander, and from a finikin imitation of Old Kingdom models men turned to gross and wooden imitations of the imperial style again in temple reliefs and in statuary. All art became gradually worse; the Saite delicacy was soon entirely lost, what there was of grace and beauty in the first Ptolemaic century disappeared at the end of the period. The roughness of the sculpture in coarser soft sandstone shows an incredible decadence, which was only emphasized under the Romans. The small arts degenerate conformably, but more slowly. The pale blue glaze continues under the Ptolemies to be very beautiful, and was often used by Greek artists to fashion purely Greek objects of art, as had already been done at Naukratis under the Saites. But a coarser, sugary glaze, often of darker colour, has also come into use and under the Romans gains the mastery. Only in metal-work, especially in gold and silversmithery, do we still find good work under the Ptolemies, and in the old Ramesside style, which had never died out; for in this domain of art archaism had never found a place, the reason being probably that there was no goldsmith's work of the Old Kingdom known to the Saites which they could imitate. We, with our knowledge dervied from archaeological excavation

which enables us to survey the whole course of Egyptian art-history from beginning to end, know far more of these things than the ancient Egyptians of any one period knew themselves.

The Roman Period: the End.—Of Egyptian art under the Romans one can only speak as a dead thing. The only thing worth looking at is the faience, with its characteristic semi-transparent dark blue glaze, often laid on over yellow to give the effect of green. A fine hard black glaze was also used, as well as an apple-green. The sculpture is dry and dull; half-Romanized portraits of classical and Egyptian style are produced, of horrific tastelessness. The temple reliefs are abominable, barbarous, and as bad as anything that the Nubian imitators of Egyptian art at Napata and Meroe have produced. Egyptian art could not exist any longer by the side of Graeco-Roman art; it was not only provincial, it was definitely barbarous, the childish performance of "natives," which could only cause amusement to the citizen of the modern world-empire of Rome. So old Egypt expired, "a driveller and a show." She left a few motives, of religious origin, to the "Coptic" art of the Christian period, which otherwise was Syro-Roman in style. The ancient symbol of "life,"  , easily became the Christian cross.

ARCHAEOLOGY: DETAIL

Agriculture.—As now, Egypt's staple industry was her agriculture. She early became a granary for the surrounding world, and her corn was no doubt exported to the Aegean or to Syria in ancient days almost as largely as it was to Rome later on. Ancient pictures of the fellahin at work in the fields have much the same appearance as modern representations of the same scenes. The crops were much the same as to-day. Wheat and spelt were used for making bread, of which many ancient specimens have been preserved in the tombs to our own day. There is no possible truth in modern tales, constantly repeated, of ancient mummy-wheat being planted nowadays and producing a crop; the germ cannot live so long, and the grain in question is always certainly modern. Barley was used for making beer. The vine was cultivated and wine made in Egypt, especially in the Oases and the Mareotic district of the delta; nowadays the climate is considered too dry and hot for the production of good wine. The date-palm was as important as it is now. Bee-keeping was a very ancient industry. The title of the king as king of Upper and Lower Egypt meant "Bee-man" (byati)  .

Honey was much eaten; cane-sugar of course being unknown. Land was usually held by the farmers from a landlord, either the king, a feudal chief, temple-chapter, local squire (a farmer himself) or in late times a wealthy townsman. The king was the nominal owner of all land, but in practice, even at the height of the royal power, he could not claim to own directly the lands of the priests, and if he dared to confiscate any he gained a very bad reputation thereby.

Animals.—The oldest domestic animals of the Egyptians were asses, oxen, sheep, goats, pigs, dogs, cats, geese and ducks. The pig is not often represented, as it was considered unclean. A peculiar breed of sheep, with long twisted horizontal horns, died out as early as the 18th Dynasty, but its peculiar type continued to be represented in the ram-headed god Khnum (confused with the goat of Mendes). The ordinary breed with helically-twisted horns was the animal of the god Amon. The dog was domesticated very early, as the hound and the turnspit were differentiated as early as the Middle Kingdom. The cat was probably not so domesticated as it is to-day, but as the animal of the goddess Bastet was held in high honour. The horse was not introduced from the East till the time of the Hyksos, with the chariot; the domestic fowl not till that of the 18th Dynasty, when its phenomenal powers of laying were regarded with wonder ("the bird that brings forth eggs every day"). Neither horse nor fowl ever were regarded as sacred, or gave heads to Egyptian therianthropic gods, although in very late Roman times a cock-headed Gnostic demon evolved, probably through some confusion with the hawk-headed Horus. The Egyptian breed of horses became famous in later times, as we see from a well-known biblical reference (1 Kings, x., 28); and in the 8th century king Pi'ankhi in an expedition from Nubia extends his clemency to those princes who treated their horses well, and censures one for neglecting his. The horse was not ridden till Saite times. The donkey and the pig dispute the honour of giving a head to the god Set. The camel was never used in the Nile valley being confined to the Arabian desert, and is never represented till the latest period. The baboon and other species of apes can hardly be regarded as domesticated, but were well-known from early days especially the dog-headed baboon, the animal of Thoth, the god of learning. The elephant was not generally domesticated, or used in war till Ptolemaic days. It was however well known from predynastic days, and later often brought as tribute from Asia, where it still lived in North Mesopotamia and Syria. The lion, also brought from inner Africa and Mesopotamia (where it still existed till the middle of the 19th century in the Euphrates marshes) was trained to accompany the king (under the 18th and 19th Dynasties) in war.

The tiger, of course, was unknown to the Egyptians, but the hyena, wolf and jackal were indigenous, the two latter animals being held in high religious honour, the jackal being thus placated in very early days in order to persuade him not to ravage the graves of the dead in the desert (see *Religion*). The giraffe was brought from Kordofa, as tribute from the negroes, with the baboon. The hippopotamus and crocodile were among the commonest denizens of the Nile; the former persisted in the Delta till the beginning of the 19th century, while the latter was only quite recently retired from Upper Egypt and Nubia to the region south of the Second Cataract. Both gave heads to Egyptian deities. Of other non-domesticated animals the ibis is the best known: also sacred to Thoth (see *Religion*).

Architecture (see also *Art*).—There is a model in the British museum of a pre-dynastic house, a box of pottery with a lid, in the shape of a long hut with a door with beam-architrave. The well-known Egyptian splay and torus moulding is certainly of predynastic origin, being an imitation of the splaying tops of the rows of reeds of which a reed hut was built, bound together by a roll of cord along the length of the roof. Details of stone shrines in later days which are evidently modelled on wooden originals (at Dair al-bahri under the 11th Dynasty, the carved limestone is painted to imitate the grain of wood) show strong and well-designed carpenter's work in early building. Although brick may be an Egyptian invention independent of Babylonia, wall-details were either borrowed from Babylonia, or by both Egypt and Babylonia from a common source. The sudden development of stone building under the 3rd and 4th Dynasties has been described, and the stereotypes of temple-details under the 5th. Of Middle Kingdom buildings we have the 11th Dynasty funerary building at Dair al-bahri and that of the 12th at Lisht, besides the pyramids of the kings at Dashur, Lahun and elsewhere. The undecorated walls, built of gigantic stones, of the "Temple of the Sphinx" at Gizeh and the Osireion at Abydos, which have been attributed to this dynasty, are certainly in the case of the Osireion much later, belonging to 19th, while the view that the Gizeh building may be of the Pyramid epoch is not disproved. Both are subterranean buildings built for certain funerary purposes connected with Osiris in the underworld. The temple developed its full magnificence under the 18th and 19th Dynasties. While the gods were housed in halls of granite and sandstone, the kings continued to live in palaces of mud-brick, decorated however with beautiful wall-paintings: stone being confined to pillar-bases and thresholds, sometimes also doorjambs, architraves and beams being of wood. Large halls were often built of this construction. The systematic excavation of the ruins of Akhetaten, the town of Ikhnaton at Amarna by the Egypt Exploration Society, following the work of the German Orient-Gesellschaft, is teaching us much regarding Egyptian domestic architecture. Streets were broad at Akhetaten, and suitable for chariots abreast, but the town was a new foundation, and we cannot doubt that the alleys of an old city were as tortuous and noisome as they are to-day. Housebuilding has really altered very little in Egypt or in 'Iraq, and the ways of the people are the same as in ancient days: in few countries is the complete continuity of modern civilization with that of four thou-

WALL PAINTINGS OF THE 18TH DYNASTY

e tomb at Thebes of Rekhmire, Vizier of
picting negroes bringing tribute of ebony,
opard and a monkey Abo t 1450 B.C

2. Two of the *seven* daughters of King kfnatu
from a esco at el-Amarna he k gs
Amarna per d about 13 0 B.C 18th dynast

and years ago so evident as in Egypt. Foreign ideas appeared from time to time sometimes owing to a royal whim as in the famous case of the outer gate of the temple of Rameses III. at Medinet Habu, which is an imitation in sandstone of a Syrian *migdol* or fortified tower. In later days the temple-architecture becomes coarse and ugly, until revived and refined to some extent by Saite archaism. The Ptolemaic age has left us at Dendera, Edfu, and elsewhere the only completely roofed and well-preserved temple-buildings we have; Edfu indeed is practically perfect and gives a magnificent idea of what an older temple was like, for though the Ptolemaic sculptors could only design wall-reliefs childishly, the architects were well able to reproduce the buildings of the past. Even the Roman age at Esneh has left no inconsiderable monument. Details of course altered in time, became misunderstood, debased or vulgarized, but the main appearance of a temple was the same as it had been under the Old Kingdom—the style was the same. There were no religious buildings in Egypt of clashing styles. The pillar capitals of the lily and papyrus orders established by the time of the 5th Dynasty (the closed lily-bud capital dates from the 3rd at Sakkara) continued to the end. The bud-capital was very popular under the 18th and 19th Dynasties, and under the 20th became a terrible caricature. The inverted flower, often used for wooden canopy pillars, was used once only in temple-architecture, by Thutmosis III. at Karnak and was not approved. By Ptolemaic and Roman times capitals became very elaborate and rococo. The art of building an Egyptian temple was simple, being merely that of the child who builds with a box of wooden bricks. It is the mass and weight of the "bricks" that are astonishing. There is no doubt that though the Egyptians possessed in early days a primitive kind of crane (probably) and a sort of rocker which could transfer heavy stones from a lower to a high position, much of their building was achieved by sheer man-hauling up mounds of earth. The Egyptian is an adept at throwing-up earth embankments speedily, on account of their necessity in the scheme of irrigation; and he built his temples by hauling the stones with ropes and levers up an earth-slope to the height demanded. An architrave was placed across two pillars in this simple way, which has been used in modern days for the restoration of Karnak. Such levers, ropes, mallets, etc., are often found in excavations of temples. Implements such as squares, plumb-lines, etc., were used. The mason's square  was a very lucky amulet.

Arms and Armour.—The first copper weapons discovered in Egypt appeared about the middle of the pre-dynastic period in the shape of triangular daggers. Axe-heads of copper, of simple rounded shape, were common under the earlier dynasties. Under the 12th Dynasty the usual Egyptian hatchet-shape was introduced, sometimes for weapons of parade with decoration of groups of animals in open-work, sometimes with scenes in inlaid metal work, as in the case of the famous dagger of Queen A'ahhotep in the Cairo museum. Decoration of this kind, showing pictures of fighting and hunting in variously coloured metals, was probably of Aegean origin, introduced into Egypt. The finest known examples are the inlaid daggers from the shaft-graves at Mycenae (*c.* 1600 B.C.). Spearheads, tanged, first appear in the early Middle Kingdom. The pear-shaped stone macehead, common as a weapon under the early dynasties, went out of use about the same time. The dagger, often with spiral inlay (also Aegean) on the blade, was hilted with a peculiarly-shaped handle of ivory. Bronze now came into use for the finer weapons. Under the Hyksos the Syrian scimitar or *Khepesh* was introduced from Asia, and became a characteristic Egyptian weapon. The axehead under the 18th Dynasty continued as before, and was still stuck through the haft and secured by leather bands; the invention of the socket, well-known in Babylonia nearly 2,000 years before, not yet having been adopted in Egypt for the axe: socketed spearheads appeared however. Long swords were of foreign make and only used by foreign mercenary troops from South-East Anatolia (Shardina and Kahak); an example is in the British Museum. A heavy bill, with a peculiar blade weighted by a round ball, which took the place of the old mace, was also probably of foreign origin. The peculiar or round pped dagge. hil. of the Middle Kingdom and early 18th Dynasty was given up in favour of a hilt of foreign type probably Aegean, made of fine stone such as crystal or chalcedony. The gold and iron daggers from Tutankhamun's tomb have hilts of this type, decorated with gold granulated chevron patterns. Bows and arrows were known from the beginning, but the Egyptian bow was not a very powerful weapon, although it was said that no man could bend the bow of king Amenhotep II. Iron known for weapon making as early as the Hyksos period (a spear of that time was found in a Nubian grave), came first into general use in the 14th and 13th centuries B.C., and by the time of the Saites was universally used in Egypt as elsewhere. bronze surviving only for weapons of parade and for arrowheads, just as stone had survived for arrowheads well into the bronze age, the commoner and cheaper material being used at all times for weapons that could not be retrieved. The Egyptian flint arrowhead was usually of a peculiar flat-edged, not pointed type, like a front tooth. For hunting plain hard wood points were generally employed. Arrows were carried in quivers, suspended at the side of the chariot. Body-armour was never in great favour in Egypt, no doubt owing to the heat. It does not appear at all till the late New Empire, when helmets, often plumed, of a laminated construction (probably, again, of Aegean origin) began to be worn occasionally, though they were never common, and armour of slats or scales of metal or bone sewn on to a leather or linen hauberk; laminated armour, apparently introduced by the Anatolian mercenaries of the time, like the big broadswords already mentioned. This "linen" armour, sometimes made with crocodile skin, was still used under the Saites, when Greek metal armour was introduced but was used probably only by princes.

Boats and Shipping.—Oared boats were known in the pre-dynastic period, and carried insignia (so-called "totem-poles"), the sacred animals or symbols of tribes (later the names) on poles. A masted and sailed boat occurs on a vase of the middle pre-dynastic period in the British museum; the sail is square. Square-sailed boats were common under the Old Kingdom and thenceforward. Great boats were used in the Mediterranean to fetch wood from Phoenicia (the Lebanon) at least as early as the 3rd Dynasty. Ships had navigated the Red sea as early as the pre-dynastic age, and are represented on the handle of the al-'Araq knife, and we find them regularly mentioned as sailing to Punt (Somaliland) at least as early as the 11th Dynasty. A tale of the Middle Kingdom tells us of the strange adventures of a shipwrecked sailor in the Red sea, and voyages to Gebal (Byblos) in Phoenicia were common. Under Hatshepsut (18th) we have representations of great sailed and oared galleys going to Punt. Whether Egyptian ships ever got so far as Babylonia or India we do not yet know, but Babylonian vessels seem to have come up the Red sea to the Sinaitic peninsula in search of stone at a very early period. In the Mediterranean, the ubiquity of the Cretan and Phoenician sailors no doubt prevented any great development of Egyptian shipping: under the 18th Dynasty we see a Phoenician ship depicted unloading at a quayside at Thebes. The anarchy in the Mediterranean after the fall of the Minoan civilization probably put an end to Egyptian maritime enterprise in the North. When an ambassador of the 20th Dynasty goes to Phoenicia he sets sail in a Phoenician ship. Under the Saites, however, we see a revival of Egyptian enterprise on the water; very large vessels were built for war service on the Nile, and Egyptian sailors fought well in the service of Persia at Artemision and at Salamis. Egyptian ships were always known by individual names, such as "Appearing in Memphis" (early 18th Dynasty), "The sun-disk lightens," (late 18th Dynasty) "The Ship of Amon," and "The Great Ship of Sais" (26th Dynasty). Sailors and shipmen, especially those of the royal barges, are often mentioned on the monuments. *Canopic Jars, Coffins, etc.* (see *Religion.*)

Ceramics.—Egypt affords us the most striking instance of the development of the potter's art. As in other countries pottery was made even in Neolithic times, for the Nile mud forms a fine plastic clay and sand is of course abundant. With these materials, various kinds of pottery, often extremely well made and of good form, have been continuously produced for common domestic

[illegible] be called pottery at all, it contained so little clay. Yet as early as the 1st Dynasty the Egyptians had learnt to shape little objects in this tender material and cover them with their wonderful blue glazes. We have therefore to study the development of two independent things. (1) the ordinary pottery of common clay left without glaze; (2) the brilliant glazed faience which appears to be special to Egypt, though it may have been the groundwork for the technique of the slip-faced painted and glazed pottery of the nearer East. We probably possess specimens of the most primitive Neolithic pottery in that of "Badarian" type recently found by Sir Flinders Petrie at al-Badari in Upper Egypt. The black and red ware of Ballas and Naqada is later. This ware is very hard and compact and the face is highly burnished. The red colour was produced by a wash of fine red clay; the black is an oxide of iron obtained by limiting the access of air in the process of baking, which was done, Prof. Sir Flinders Petrie suggests, by placing the pot's mouth down in the kiln, and leaving the ashes over the part which was to be burnt black. Both red and black colour go right through in every case. All-red and all-black vases are occasionally found, the red with geometrical decorations in white slip colour, and the black with incised decoration. The forms are usually very simple, but at the same time graceful, and the grace of form is more remarkable when it is remembered that none of this early pottery was made on the wheel.

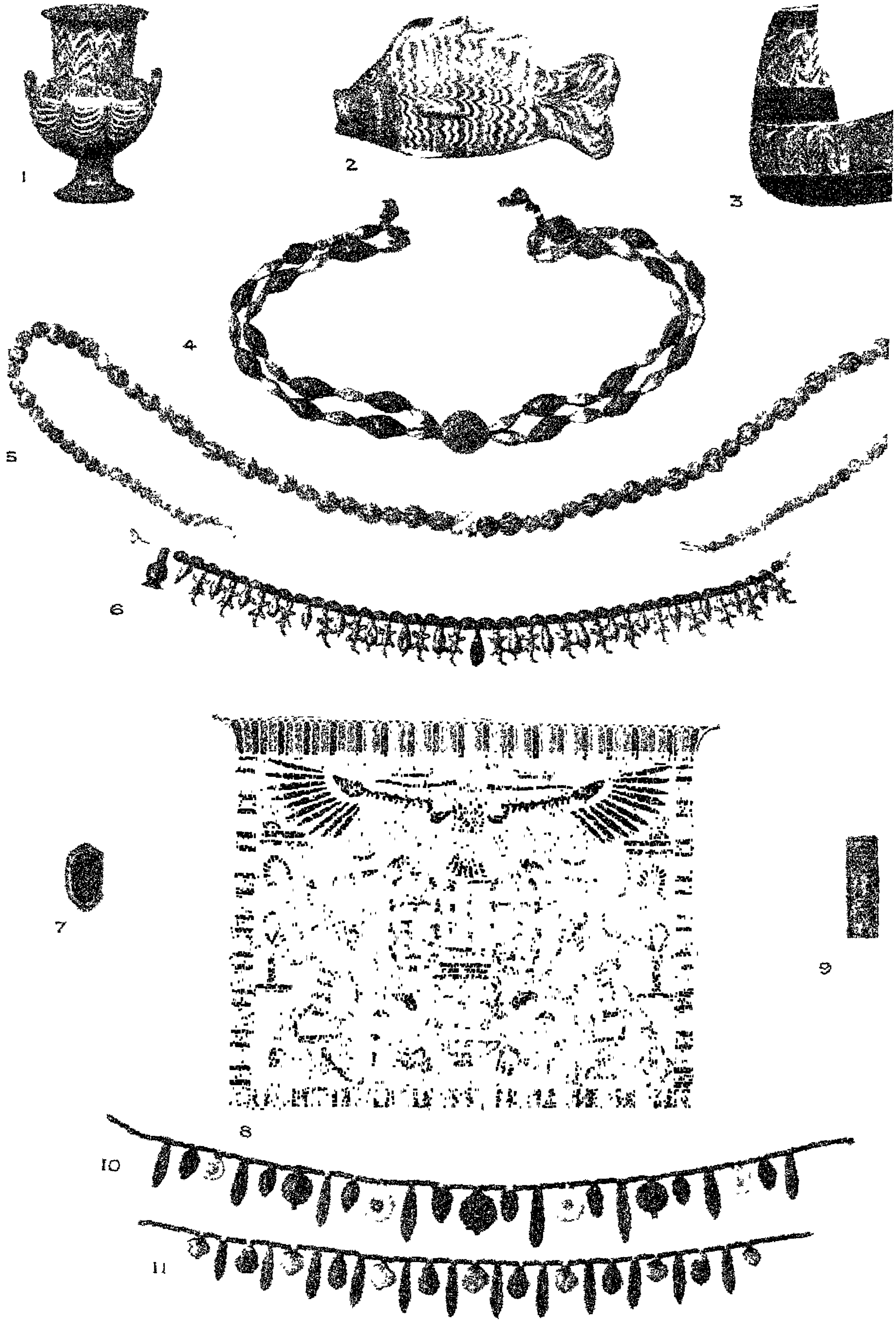
A very similar red and black ware, usually of thinner and harder make, and often with a brighter surface, was introduced into Egypt at a later date (12th Dynasty), probably by Nubian immigrants who were descended from relatives of the Neolithic Egyptians. From their characteristic graves these people are called the Pan-Grave people, and their pottery is known by the same name.

Later in date than the early red and black wares, the second characteristic type of primeval Egyptian pottery is a ware of buff colour with surface decorations in red. These decorations are varied in character, including ships, birds and human figures; wavy lines and geometrical designs commonly occur (see *Art*). They are the most ancient handiwork of the Egyptian painter, and mark the first stage in the development of pictorial art on the banks of the Nile. Some other types of pottery, in colour chiefly buff or brown, were also in use at this period; the most noticeable form is a cylindrical vase with a wavy or rope band round it just below the lip, which developed out of a necked vase with a wavy handle on either side. This cylindrical type, which is probably of Syrian origin, outlived the red and black and the red and buff decorated styles (which are purely pre-dynastic) and continued in use in the early dynastic period, well into the copper age. The other unglazed pottery of the first three dynasties is not very remarkable for beauty of form or colour, and is indeed of the roughest description, but under the 4th Dynasty we find beautiful wheel-made bowls, vases and vase-stands of a fine red polished ware. Under the 12th Dynasty, and during the Middle Kingdom generally, a coarser unpolished red ware was in use. The forms of this period are very characteristic; the vases are usually footless and have a peculiar globular or drop-like shape—some small ones seem almost spherical.

The art of making a pottery consisting of a siliceous sandy body coated with vitreous copper glaze seems to have been known unexpectedly early, possibly even as early as the period immediately preceding the 1st Dynasty (4000 B.C.). The oldest Egyptian glazed ware is found usually in the shape of beads, plaques, etc.—rarely in the form of pottery vessels. We find tiles made of it at Sakkara under the 3rd Dynasty, and under the 6th and 12th Dynasties pottery made of this characteristic Egyptian faience came into general use and continued in use down to the days of the Romans, and is the ancestor of the glazed ware of the Arabs and their modern successors. The colour is usually a light blue, which may turn either white or green; but beads of the grey-black manganese colour are found, and on the light blue vases of King Aha (who is probably one of the historical originals of the legendary Mena or Menes) in the Brit. mus. No. 38,0[illegible] [illegible] the king's name traced in the manganese glaze on (or rather in) the blue-white glaze of the vase itself, for the second glaze is inlaid. This style of decoration in manganese black or purple on copper-blue continued till the end of the "New Empire" shortly before the 26th (Saite) Dynasty. It was not usual actually to inlay the decoration before the time of the 18th Dynasty. The light blue glaze was used under the 12th Dynasty (Brit. mus., No. 36,346), but was then displaced by a new tint, a brilliant turquoise blue on which the black decoration shows up in sharper contrast than before. This blue, and a somewhat duller greyer or greener tint was used at the time for small figures, beads and vases, as well as for the glaze of scarabs, which, however, were usually of steaschist or steatite—not faience. The characteristically Egyptian technique of glazed stone begins about this period, and not only steatite or schist was employed (on account of its softness) but a remarkably brilliant effect was obtained by glazing hard shining white quartzite with the wonderfully delicate 12th Dynasty blue. A fragment of a statuette plinth of this beautiful material was obtained during the excavation of the 11th Dynasty temple at Deir el-Bahri in 1904 (Brit. mus., No. 40,948). Vessels of diorite and other hard stones are also found coated with the blue glaze. A good specimen of the finest 12th Dynasty blue-glazed faience is the small vase of King Senwosri I. (2400 B.C.) in the Cairo museum (No. 3,666). The blue-glazed hippopotami of this period, with the reeds and water-plants in purplish black upon their bodies to indicate their habitat, are well known (Pl. VII., figs. 1 and 2). Fine specimens of these were in the collection of the Rev. Wm. MacGregor at Tamworth.

The blue glaze of the 12th Dynasty deepened in colour under the 13th to which the fine blue bowls with designs (in the manganese black) of fish and lotus plants belong (Pl. VII., fig. 9) (Brit. mus., Nos. 4,790, etc.). The finest specimens of 18th Dynasty blue ware have come from Deir el-Bahri, in the neighbourhood of which place there may have been a factory for the manufacture of votive bowls, cups, beads, etc., of this fine faience for dedication by pilgrims in the temple of Hathor (good collection in Brit. mus.). Towards the end of this dynasty polychrome glazes came into fashion: white, light and dark blue, violet, purple, red, bright yellow, apple-green and other tints were used, not only for smaller objects of faience, such as rings, scarabs, kohl-pots, etc., but also for vases, *e.g.*, No. 3,965 of the Cairo museum (Amenophis III., wine-bottle), the ground colour of which is white with a decoration of flower wreaths in blue, yellow and red, with an inscription in delicate blue. An unglazed but finely polished red ware was in use at this time that may be of Syrian origin. Vases of the same ware in the shape of men and animals are not uncommon. Another ware of this period has a highly polished yellow face, sometimes becoming ruddy and passing off into a pinkish red; in this ware "pilgrim bottles" are common. An unpolished, brittle and thin yellow ware was also used largely for wine-vases. The rougher, commoner red and brown ware at this period became decorated with designs chiefly of lily wreaths, etc., in paint of various colours, usually with a chalky blue ground. Marbling, in imitation of stone, was also employed. This new development hid the ugly colour of the common pottery and was a cheaply obtained imitation of the expensive polychrome glazed ware of the period (Pl. VI., figs. 1 and 3). This painted pottery continued in use until about the time of the 22nd Dynasty. From this time onwards, till the Ptolemaic period, the commonest pottery was a red ware, usually covered with a white slip. Under the 26th Dynasty a finer homogeneous white ware occurs, usually for vases, with a rude representation of the face of the god Bes on their bodies.

The 26th Dynasty marks a new period of development in the history of Egyptian faience. The old deep blue colour had gradually deteriorated into an ugly green (Brit. mus., No. 8,962), which was replaced by the Saite potters with a new light blue of very delicate tint, imitated in accordance with the archaistic spirit of the time, from the old light blue of the earliest Dynasties. The glaze itself is very thin. The old decoration of the blue with designs and inscriptions in manganese black is ab[illegible]



Y OF THE DIRECTORS SERVICE DES ANTIQUES CAIRO

GLASS, JEWELLERY AND FAIENCE FROM THE XII. TO THE XVIII. DYNASTY (2000–135

es of *polychrome glaze*. 18th dynasty. *c.* 1400 B.C 4–6. Necklaces ian gold, amethyst and jasper (4 and 5, *c.* 2000 B.C.; *6*, *c.* 1450 Faience scarab *in gold mounting*. 12th dynasty c. 2000 B.C. 8. *ctoral* of gold, carnelian, lapis lazuli and [illegible] [illegible] wings [illegible] the [illegible]

vulture goddess Nekhebet-Dahshur. 12th *dynasty*, *c.* 2 *steatite cylinder-seal* of Queen Sebeknefru. 12th dynasty Necklaces of polychrome faience, with pendants *dy* [illegible] 1400 B C

doned on the *ushabtis* the inscriptions are now incised. Side by side with this light blue glaze was used an unglazed faience, a sort of composition paste with the colour going right through which had already appeared on pale blue under the 18th Dynasty. (Some of these figures appear to have been made with a mixture of sand, clay and coloured glass which produced a real glassy porcelain—the earliest porcelain of which we have any record.) It has more variety of colour than the glazed faience, light green and a dark indigo blue being found as well as the Saite light blue. Sometimes it is of a very soft, almost chalky consistency. It was used for vases, but more generally for small figures and scarabs. The commonest vase-form of this period is the pilgrim bottle, now made with the neck in the form of a lily flower, and with inscriptions on the sides wishing good luck in the New Year to the possessor. These flasks appear to have been common New Year gifts.

Under the Sebennytite kings of the 30th Dynasty a further new development of glaze began, of a more radical character than ever before (see *Art*). The colour deepened and the glaze itself became much more glassy, and was thickly laid on. The new glaze was partly translucent, and differed very greatly from the old opaque glaze. It first appeared on *ushabtis* at the end of the Saite period. A curious effect was obtained by glazing the head-dress, the inscription, etc., of the *ushabtis* in dark blue, and then covering the whole with translucent light-blue glaze. This method was regularly used during the succeeding Ptolemaic and Roman periods, when the new style of glaze came into general use. A yellowish green effect was obtained by glazing parts of the body of the vases in yellow and covering this with the translucent blue glaze. This method was used to touch up the salient portions of the designs in relief, imitated from foreign originals, a style which now became usual on vases. The usual decoration is mixed Egyptian and classical, the latter generally predominating. A large range of colours was employed; purple, dark blue, blue-green, grass-green and yellow glazes all being found. The glaze is very thickly laid on, and also is often "crazed." A remarkable instance of this Romano-Egyptian faience is the head of the god Bes in the British museum (No. 35,028). A hard, light blue, opaque glaze like that of the 26th Dynasty is occasionally, but rarely, met with in the case of vases (Brit. mus., Nos. 37,407, 37,408).

We know something of the common wares in use during this period from the study of the *ostraka*, fragments of pottery on which dated tax-receipts, notes and so forth were written. From the *ostraka* we see that during the Ptolemaic period the commonest pottery was made of red ware covered with white slip which has already been mentioned. At the beginning of the Roman period we find at Elephantine a peculiar light pink ware with a brownish pink face, and elsewhere a smooth dark brown ware. About the 3rd century A.D. horizontally ribbed or fluted pots, usually of a coarse brown ware, came into general use. These were often large-sized *amphorae*, which had very attenuated necks and long handles. During the Byzantine (Coptic) period most of the pottery in use was ribbed and usually pitched inside to hold water, as the ware was loose in texture and porous.

During the Coptic period, a lighter ware was also in use, decorated with designs of various kinds in white, brown or red paint on the dull red or buff body. In Nubia a peculiar development of this ware is characteristic of the later period (Brit. mus., No. 30,712).

A polished red ware of Roman origin (imitation Arretine or "Samian") was commonly used as well

The heavily glazed blue faience continued in use until replaced in the early Arab period by the well-known yellow and brown lead-glazed pottery, of which fragments are found in the mounds of Fostat (old Cairo).

Chariots, used both for war and peace, were introduced into Egypt from the East in the time of the Hyksos, about 1800 B.C. They came with the horse. They were of very light construction, and of very broad gauge, suitable for use in rocky land and for swift movement. The wheels usually had four spokes and thick leather tyres But the wheels are of the same type, especially as regards the pole and method of securing the reins to it, as the oldest chariots known in Babylonia, where the chariot was invented by the Sumerians before 3000 B.C. The Sumerian wheels were originally made of three pieces of wood, an elliptical piece between two demilunes, secured by two cross-buttons, one above, the other below the hub. Spokes were invented later. The Sumerians invented the chariot before the horse was known to them; originally they harnessed asses to it. From Babylonia the invention of the wheel and the car spread to Anatolia and to Greece probably before it reached Egypt. Although usable in Egypt only in the desert, the horse and chariot must have contributed materially to the success of the Hyksos invasion. The Egyptians took up the invention literally "with a vengeance," and the Egyptian chariotry became the most famous in the world. Cavalry were never used by the Egyptians.

Costume: see *Dress*.

Excavations: see *Archaeology* and *Art*.

Furniture.—Wood was early used for the making of furniture, which under the earliest dynasties was already becoming elaborate. Our finest examples are of the 18th Dynasty. A characteristic form was a stool with folding legs, of exactly the modern form; the legs were habitually made in the form of goose-heads. Lion-claws were used for larger chairs, which often had backs, and are of very modern appearance. The Egyptians sat on chairs, and never reclined at meals, as the Greeks and Romans did. Cushions were usual. Long beds, boxes of various kinds, etc, were made, often of rare inlaid woods and combined with thick gold overlay.

Government.—The king was a god in human form, and was so regarded, at any rate conventionally and by courtesy, even in the later days after the 18th Dynasty, when Egypt came into contact with other kings who claimed no such dignity But the government was no theocracy The "good god" was usually a very human person, and except when dressed up for religious festivals, had very little of the priest about him. Queens regnant in their own right were not really "constitutional," and were not recognized "in law," we have records of only two, Skemiophris of the 12th Dynasty, and Hatshepsut of the 18th. Hatshepsut masqueraded as a man. Probably Skemiophris, of whom we know next to nothing, did not. The Herodotean queen Nitôkris of the 6th Dynasty never existed; the Nitagri of that time was a king. The king exercised his power through ministers at all periods and through feudal chiefs: in times of royal weakness the latter were practically independent. The later kings of the 12th Dynasty suppressed the local dynasts, and by the time of the 18th Dynasty a bureaucracy presided over by royal sheriffs had taken their place. The chief minister, or vizier, was the *Zate*, "the Man," as opposed to "the God," *i.e.*, the king. This was no doubt a very ancient title. It is often mistranslated "mayor," but the *Zate* was a much more important person than a mere mayor of Thebes, although he bore the title of "Zate of the city," *i.e.*, Thebes, as capital of the South. A Northern vizier was also appointed under Thutmosis III., with his seat at Memphis. Nubia was governed by "the King's Son of Kush," not necessarily, or usually, a royal prince, however. The Asiatic conquests were looked after by travelling commissioners, so far as can be ascertained, when the government was not military. There seems, however, to have been a viceroy in Phoenicia. The vizierate might descend from father to son, but a strong king would never allow a dynasty of viziers to grow up who might soon become "mayors of the palace" and kings themselves. At the installation of the vizier the king delivered to him a charge, detailing his duties, copies of which exist in three tombs of viziers under the 18th Dynasty. In practice the power of the vizier was checked by the complete independence of the financial power under the king's treasurer and by the existence of officials called the king's eyes and ears, who watched both vizier and treasurer. The vizier was also chief justice, and presided over the Great Qenbet (see *Law*). The king was his own war-lord, foreign minister and colonial administrator, and he represented his people before the gods, offering sacrifices, and presiding over festivals. But his relations with the priesthood were by no means always friendly especially in the case of

donation and probably of his father, Amenhotep III. Under the weak kings of the 20th Dynasty the wealthy chapter of Amon at Thebes grew so powerful that the high-priest eventually himself became king. (See *History*.)

He had his own immediate court officials, who accompanied him to war. The country was divided up into *nomes*, divisions of great antiquity, which persisted with various local modifications and readjustments till the end. Normally there were 42 nomes, 22 in Upper and 20 in Lower Egypt. The ancient distinction of Lower Egypt (the Delta) from Upper Egypt was always recognized, and in times of weak government the country was always liable to fall apart into its two chief components, Memphis belonging always to Lower Egypt. In Ptolemaic times a Heptanomis of seven nomes was formed in Middle Egypt. In Upper Egypt the Thebaid (*Ptashemo*, "the city-march") had from the time of the 18th Dynasty taken a rather peculiar position as the metropolitan province, which it continued to occupy even after the practical destruction of Thebes by the Assyrians in B.C. 663. Between the Thebaid and Syene (Aswan) the valley south of Ombos was sometimes regarded as belonging to Upper Egypt, sometimes to Nubia. South of Syene again the Nubian valley as far as Hierasykaminos (Maharraka) was regarded in Roman times, under the name of *Bodekaschoinos*, as Egyptian territory, all south of it being left to the Meroitic kings. Local government of the nomes was exercised in various ways, through royal officials known as heralds (*uōhemu*), or through local magnates, who were all responsible to the vizier as the king's lieutenant. The whole country was known generally as Kēmet, "the black land," from the colour of its soil; poetically also by other names, such as *Tomera*. The Hebrew name, *Mitsraim*, and the Greek Αἴγυπτος, are both of unknown origin: the former is still used as the modern appellation of the country in Arabic, *Misr*. The Hebrew name for Upper Egypt specially, Pathros, is the Egyptian *Ptores*, "the South-Land."

Hunting, Fishing, etc.—The Egyptians were great hunters of wild animals of all kinds on the desert-margin of the valley and in the Asiatic countries subject to their sway, especially of wild oxen, antelopes and the larger cats. The hunters used not only the bow and arrow, but also a throwstick, the latter specially for wild fowl in the marshes, which were hunted from boats, as also the hippopotamus. In the desert the chariot was commonly used for hunting. Fish were chiefly netted.

Law.—No code is known; we have nothing like the laws of Hammurabi in Babylonia. There was however by Ptolemaic times a great body of law that had grown up through the centuries, based no doubt on royal enactment, like the decree of Horemheb at Karnak, the only ancient one we know, which prescribes penalties against oppression of peasants by landlords. This body of law was known to Ptolemaic and Roman Egypt as "native law," and was quoted side by side with Greek (Athenian and Ptolemaic) and Roman law. There were courts in early times, composed of royal and feudal officials; the "vizier's court" and the "great qenbet" or board of judges (assize) are mentioned. We have records of a civil trial of the reign of Horemheb in the papyrus of Mes. Special commissions were set up by the king to try special causes, *e.g.*, the cases of tomb-robbing under the 20th Dynasty at Thebes (Abbott papyrus). A single commissioner enquired into a delicate matter in the royal harem under the 6th Dynasty (Inscr. of Uni). Penalties of death, nose-cutting, banishment to the mines, the bastinado, etc., were inflicted, death usually being inflicted by beheading. Written legal instruments and documents existed at all times, but actual extant examples date chiefly from the later period. They are quite modern in character and phraseology. Inheritance passed largely through the mother. Matriarchal ideas were very prevalent in Egypt, where marriage was, we should consider, rather promiscuous. Brother-and-sister marriage was not uncommon, and seems to have been usual in the royal family. A concubine was as usual as the proper wife (*hēmet*), and was often known by the name of "sister" (*snē-t*).

Metals and Minerals.—Copper, gold and iron were known in middle pre-dynastic times, the latter no doubt only in its aerolithic form, and very rarely. Copper came from Sinai and further afield in Asia (also no doubt from Cyprus), its knowledge probably from Babylonia or Syria. It was not only used for weapons etc., but also for making the copper frit of which the blue glaze was composed. Gold was early obtainable from Nubia, and later from Asia and Anatolia, whence also came silver, always rarer in Egypt than gold. The electrum mixture was used at least as early as the 12th Dynasty; in Babylonia it had been known before 3000 B.C. Whence tin came for bronze-making (not long before 2000 B.C.) we do not know. Antimony was found nearer home. Lead was known, of course, at the same time as silver. Galena was used for making *kohl* or eye-paint even more commonly than antimony, as early as 2000 B.C. Corundum (emery) must have been brought from the Aegean already in the pre-dynastic period for making stone vases. Iron did not come into use, and then but rarely, for weapon-making till about 1800 B.C., and was a precious metal reserved for royal use, like gold, as late as the 14th century (Tutankhamun's dagger), but soon thereafter comes into common use. Haematite was always well known. Manganese was used for making dark purple glaze. Cobalt was not used till a late period, for colour and glaze.

Metal-work, Plate and Jewellery.—Egyptian gold chiefly came from the Nubian mines in the western desert in the Wadi 'Alāki and the neighbouring valleys. A map of these mines, dating from the time of Rameses II. (1300 B.C.), has been preserved. Silver was not mined in Egypt itself, and came mostly from Asia Minor, even at the earliest period. Then gold was comparatively common, silver a great rarity. Later, gold appears to have been relatively more abundant than silver, and the difference in value between them was very much less than it is now.

In the language of the hieroglyphs silver is called "white gold," a fact which points strongly to the priority of the use of gold, which archaeological discoveries have rendered very probable. Among the treasures of the "royal tombs" at Abydos, dating to the 1st and 2nd Dynasties, much gold was found, but no silver. On the walls of one of the tombs at Beni Hassan there is an interesting representation of a gold- and silver-smith's workshop, showing the various processes employed—weighing, melting or soldering with the blow-pipe, refining the metal and polishing the almost finished bowl or vase. Owing to the Egyptian practice of burying with their dead personal ornaments, the amount of gold jewellery that has been discovered is very large, and shows the highest degree of skill in working the precious metals. Jewellery reached its acme of taste under the 12th Dynasty, to which the beautiful PARURES belong that were found in the tombs of princesses at Dahshur and Lisht (Cairo mus., Met. mus. N.Y.). The inlays of semi-precious stones, such as blue felspar and carnelian, in gold settings that are characteristic of this jewellery, is remarkable for its beauty. Under the 18th Dynasty we have the jewellery of Tut'ankhamun, with a more lavish use of gold, but the same technique of inlay with stone. Enamel inlay begins about this time, and is well represented from Egypt, whose fine goldsmith's work was renowned in the ancient world and is well represented in our museums. Gold signet-rings were a specially Egyptian characteristic, especially under the 26th Dynasty, when they were particularly heavy and of solid workmanship. Under the 18th Dynasty gold scarabs were commonly mounted as swivel-bezels of gold rings (see *Scarabs*). We can form some notion of what the larger works, such as plates and vases in gold and silver, were like from the frequent representations of them in mural sculpture and paintings. In many cases they were extremely elaborate and fanciful in shape, formed with the bodies or heads of griffins, horses and other animals, real or imaginary. Others are simple and graceful in outline, enriched with delicate surface ornament of leaves, wave and guilloche patterns, hieroglyphs or sacred animals. A gold vase of the time of Tethmosis (Thothmes) III. (18th Dynasty, about 1500 B.C.), taken from a wall-painting in one of the tombs at Thebes shows this. The figure on its side is the hieroglyph for "gold." Others appear to have been very large and massive, with human figures in silver or gold supporting a great bowl or crater of the same metal. Vases of this type were, of course, manufactured in Egypt itself, but many of those represented in the Theban tombs were tribute mostly of Phoenician

EGYPT

MUSEUM

NCE AND GLAZED POTTERY FROM THE I. DYNASTY TO THE RC PERIOD (3200 B.C.–A.D. 150)

ynasty, c. 2000 B.C. 3. Faience bowl
nasty, c. 350 B.C. 4. Falcon for inlay,
. Roman period, A.D. 150. 6. Part of
dynasty c 1780 B C 7 a d 8 Faience
asty 13 0 B C 9 Fa ence bow
Early 18th dynasty, c. 1500 B.C. 10. Mouse, polycl
c. 2000 B.C. 11 Ape, blue, discoloured. 1st dynasty
Lotus cups blue glaze 18th 22 d dy asty 400–
ck from omb o k ng khnaton 18 h dynasty 1365

workmanship. But plate of really foreign type as well as origin was also brought to Egypt at this time by the Keftian ships from Keftiu, the island of Crete, where the "Minoan" culture of Knossos and Phaestos was now at its apogee. Ambassadors from Keftiu also brought gold and silver vases as presents for the Egyptian king, and on the walls of the tomb of Sennemut, Queen Hatshepsut's architect, at Thebes, we see a Keftian carrying a vase of gold and silver which is almost the duplicate of an actual vase discovered at Knossos by Sir Arthur Evans. The art of the "Minoan" and "Mycenaean" goldsmiths exercised considerable influence upon that of the Egyptians; under the 20th Dynasty, about 1150 B.C., we find depicted on the tomb of Rameses III. golden stirrup-vases (*Bügelkannen*) of the well-known Mycenaean type, and in that of Imadua, an officer of Rameses IX., golden vases imitating the ancient Cretan shape of the cups of Vaphio.

The chief existing specimens of Egyptian plate are five silver *phialae* (bowls), found at the ancient Thmuis in the Delta, and now in the Cairo museum (Nos. 482–486 in the catalogue). These are modelled in the form of a lotus blossom, most graceful in design, but are apparently not earlier than the 4th century B.C. Of the splendid toreutic art of a thousand years before, of which we gain an idea from the wall-paintings mentioned above, but few actual specimens have survived. The Louvre possesses a fine gold patera, 6½ in. across, with figures of fishes within a lotus border in *repoussé* work; an inscription on the rim shows it to have belonged to Thutii, an officer of Tethmosis III. (*Mém. soc. ant. de France*, xxiv. 1858).

A splendid bronze bowl, which shows us what some of the finer gold and silver plate was like, was found in the tomb of Hetaai, a dignitary of the 18th Dynasty, at Thebes, a few years ago, and is now in the Cairo museum (No. 3,553 in von Bissing's catalogue). The engraved decoration, representing birds and animals in the papyrus-marshes, is a fine piece of native Egyptian work.

Military Organization.—The armed force of Egypt was early organized from levies of the young men, and we find this levy at least as early as the 6th Dynasty. Under the 18th one of the titles of the great minister Amenhotep, son of Hapu (temp. Amenhotep III.) was what we should call "director of recruiting"; he oversaw the conscription of the young warriors throughout the land. We possess interesting models of an earlier date, 11th Dynasty (at Cairo), of two companies, one of Egyptians, the other of black soldiers, armed with spears. At Dair al-bahri (18th Dynasty) we see a parade of soldiers, led by officers armed with battleaxes, advancing at a swift springy step. Under the 19th we find the army used by Rameses II. against the Hittites organized in legions known by the names of the gods, such as the "Legion of Amon," the "Legion of Ptah," and so on. These were native Egyptian troops. Large numbers of foreign mercenaries, Syrians, Anatolians from Pisidia and Lydia chiefly, and Libyans (Shardina, Kahak, etc.), began to be employed at the end of the 18th Dynasty, and were regularly used by Rameses. They wore their own native armour and weapons, and the Shardina formed the royal guard. Libyan warriors settled in large numbers in Egypt, and after a time formed a standing body of foreign soldiery, gradually mixed more and more with natives through intermarriage. Leaders of this military organization of Libyan-descended families ("the great chiefs of Ma") eventually became so powerful as to impose a dynasty (the 22nd) on Egypt, the first king of which was Sheshenk or Shishak, the conqueror of Jerusalem (*c.* 947 B.C.). Under the Saïtes Herodotus speaks of a regular class of professional hereditary warriors called "Kalasiries" and "Hermotybies." The first name is the Egyptian *Kal-shere*, "young Syrian," and dates from the time of the Syrian mercenaries; the second is the Egyptian *Rom-debâ* ("men of the spear"). At the same time foreign mercenaries, chiefly Jewish, were stationed on the frontiers (*e.g.*, at Aswân), and Greek soldiers of fortune began to be employed. Under the last native kings (4th century B.C.), the army was almost wholly composed of these Greek mercenaries under their own generals, hired for the occasion, like Agesilaos, the aged king of Sparta, and Mentor, the admiral to whose treachery the final destruction of the native kingdom was due. Under the Ptolemies the same system was followed.

Music.—Many ancient Egyptian musical instruments have been recovered from the tombs and are represented on the monuments. The most typically Egyptian of all was the *sistrum*, with its small discs shaken on wires, which has survived as a church instrument in Abyssinia. The true harp, with sounding-board, was greatly developed, and often of great size like the modern harp which it resembled. Flutes or rather pipes of various kinds were also employed, besides trumpets, cymbals, and no doubt drums. Lyres and citharae were introduced in Ptolemaic times from Greece.

Painting (see *Art*).—Egyptian wall-painting was in distemper not fresco. Simple colours, a soot-black, an ochre red and yellow, a copper blue and green, were employed. (Inks were red and black; the Egyptians were certainly the inventors of ink made with a solution of gum). The great period of wall-painting was from the 12th to the 19th Dynasty; after this it disappeared, except for a revival of coloured relief under the Saïtes.

Priesthood (see *Religion*).

Scarabs.—The Egyptian scarab is an image of the sacred dung-beetle, *Scarabaeus* or *Ateuchus sacer*, which was venerated as a type of the sun-god. Probably the ball of dung, which is rolled along by the beetle in order to place its eggs in it, was regarded as an image of the sun in its course across the heavens, which may have been conceived as a mighty ball rolled by a gigantic beetle. The beetle was called *khepr*, the god in beetle-form *khopri*, and the beetle sign was used to spell the word *khōpe* (*r*), "to become," which as a substantive meant "transformation" or "phenomenon." The beetle was mummified. Towards the end of the Old Kingdom amulets of blue faience or ivory in the form of the beetle began to be made, on a flat base with plain markings or meander-patterns. Spiral decorations derived from the Aegean began to be employed, and at the beginning of the 12th Dynasty inscriptions appeared, usually the name of the owner or of the reigning king, as a lucky talisman. Glazed steatite and other stone scarabs were now made, which were hard enough to be employed as seals, the incised inscription leaving its impression in relief on the clay sealing of a document. Obsidian, amethyst, crystal, felspar, etc., were used for seal-scarab making also, and very often the seal was cut on a gold, electrum, or silver plate cemented to the base (see *Art*). This use of the scarab persisted till the end. Scarabs of the 12th and 13th Dynasties have very beautiful spiral and other designs, as well as inscriptions, on their bases. A peculiar, rather barbaric, style of decoration was introduced under the Hyksos, in which designs of lions and bulls, typifying the king, overcoming crocodiles, besides other types, appear. Under the 18th Dynasty the scarab reaches its greatest beauty of cutting and glaze. Characteristic of the end of the dynasty are regular issues of gigantic scarabs with inscriptions commemorating such events as the marriage of the king Amenhotep III. and Queen Tiye, the slaying by the king of lions and wild bulls in the hunt, etc. (examples in the British museum). Under the 19th Dynasty the scarab degenerates, being generally of faience coarsely glazed and cast in a mould, though some fine ones of red stone or lapis with royal inscriptions were still made. Under the Saïtes fine stone scaraboids, rather than scarabs (the representation of the wing-cases and legs being dispensed with), with delicately cut inscriptions containing lucky sentiments and prayers, were popular. The scarab suddenly disappears at the end of the 26th Dynasty, but Phoenician and Greek imitations of it, generally in sard, continued to be made abroad, the latter with classical *intagli*. Large numbers of Phoenician scarabs have been found at Tharros, in Sardinia. The small seal-scarab was always perforated along its length to be strung with others or with beads; under the 18th Dynasty it is often found so strung, but it was also mounted in the swivel-bezel of a finger-ring. Base-less scarabs, uninscribed, of hard stone, occur in late times. A larger form of scarab, inscribed on the base with the *Heart-chapter* (XXXB) of the *Book of the Dead*, usually of hard green stone, often mounted in gold, as prescribed by the ritual, was placed as the heart of the mummy as early as the Middle Kingdom. This scarab is often human-headed. Chapter lxiv. identified the scarab with the heart. Large winged scarabs were often placed on the breast.

Seals.—As in Babylonia, the inscribed seal was early used in Egypt, at first in the form of an engraved cylinder, which was rolled over the surface of the clay sealing. Seal-cylinders, possibly derived from Babylonia, were used from the end of the pre-dynastic period till the 12th Dynasty, when they were finally superseded by the scarab-seal (see *Scarab*). The sign for seal,  , is a picture of the cylinder rolling over the clay. Later on, under the Saites, signet-rings were by a false archaism made in this shape, which was supposed to represent a ring. Signet-rings of gold are known as early as the 12th Dynasty, but were commonest under the 18th and 26th Dynasties. Under the 18th they usually had swivel-bezels containing a scarab or plaque; under the 26th they were solid, made in the shape shown above. Seal-impressions of clay, being the imprint of the scarab on clay, are often found among town remains, being not seldom baked.

Stones.—Egypt is a land of easily available stone, so we find the limestones and sandstones of the desert-hills and the granites, syenites, diorites and dolerites of the Aswân region, Sinai and the Eastern desert, already used at a very early period. The fine white limestone of the Thebaid and the red granite of Aswân are well-known from the Egyptian monuments; a grey granite was also commonly used, a fine diorite in early times, and a hard basalt in Saite days. A fine reddish-yellow quartzite sandstone was also used under the 18th Dynasty, and a beautiful white quartzite under the 12th for medium-sized statues, sarcophagi, etc. Other quartz and silica stones of all kinds, such as rock-crystal, amethyst, blue felspar, garnet, onyx, sard, carnelian, rarely chalcedony, flint and chert were used at all times for small objects. Obsidian, probably both of Abyssinian and Aegean origin at first, later also from Armenia, was also used for small objects. Lapis-lazuli was imported from Persia as early as the 12th Dynasty. Turquoise was always known and commonly used.

Tombs (see *Religion*).

Tools were made from the earliest times of all kinds, much resembling those in use at the present day, and unnecessary to enumerate. Any museum with a good Egyptian collection contains specimens enough to show the chief types. Chisels were of copper till late times. We have no knowledge of any process being used to harden copper. Hard stone vases were hollowed out with copper and chert borers, with the aid of emery. Wooden mallets are among the commonest objects found in temple-excavations. The copper-adze with wood handle was of a characteristic shape  as was also the wooden hoe.  used as a plough from the earliest times. Oxen were harnessed to large-size ploughs.

Trade and Commerce.—Egyptian trade was in the form of barter. No coinage was known till the time of the last native monarchy (4th century B.C.) when a few gold staters were struck in imitation of the Greek, but with Egyptian devices. It is probable that gold and silver rings, however, took the place of coined money to a great extent as early as the time of the 18th Dynasty, being bartered for their equivalent in other commodities. Weights and measures, of course, were well-known from early times, and marked with their amounts of *kidet* or *hin*. Commerce with abroad was early developed in the direction of Phoenicia and Punt (Somaliland) by sea (*see* BOATS), with the Nubian countries both by Nile and by caravan-routes overland through the oases of Libya (6th Dynasty). Similar routes to Babylonia, across the desert, or through Syria, were used later, but were in the hands of the Syrians and Arabs. Under the 20th Dynasty a great Phoenician merchant is mentioned at Tanis named Barakat-el, who carried [illegible] ships and, probably, caravans. Such merchant-princes as these, with the East were no doubt usually not Egyptians. Commercial documents and papyri are very common from the later periods, in demotic, Egyptian or in Aramaic script. Jews monopolized commerce in Persian days, Greeks later.

Ushabti or shauabti-figures (see *Religion*) first appear under the 12th Dynasty, in stone and wood, and are of rude make, the latter with rough ink-written inscriptions. Under the 18th Dynasty very fine stone ushabtis were made; bronze is very rarely used for them. Towards the end of the dynasty they are first made of faience, usually polychrome. After the 19th Dynasty blue faience is generally employed. The ushabtis of the 21st and of the 26th Dynasty are easily distinguishable by the difference of their characteristic faience (see *Art*). They were rarely made under the Ptolemies. The latest known is one of late Roman period in the British museum, inscribed Σωτηρ ναυτης "Soter, a sailor." At first and till the end of the 6th Dynasty, the chapter of the *Book of the Dead* which deals specially with the activity of the *ushabtiu* as servants of the deceased in the underworld was inscribed or engraved upon them; but later very often only the name, title and perhaps parentage of the deceased appear preceded by the words "Illuminate the Osiris (N.H. . . .)." With every complete collection of ushabtis in a tomb are, under the 18th–22nd Dynasties, a number of similar figures carrying a whip, as *reises* or taskmasters, which are usually depicted wearing the ordinary civil dress of the period, the others being in mummy-form. Under the Saites the mummy-form only was employed. Fine royal ushabtis were made, some of the biggest known being made for the Nubian king Tirhakah. Usually they are only a few inches high.

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(H. R. H.)

SCIENCES

In considering whether or to what extent the ancient Egyptians in the field of science deserved the chorus of praise bestowed upon them by the Greek writers, except Plato, who said that, in comparison with his own people, who were of a speculative and philosophical nature, the Egyptians were a nation with a purely practical turn of mind, we find that while some Egyptologists credit the Egyptians with more speculative interest in science, there is no very strong case for this view.

I. **Astronomy.**—The practical nature of the science of the Egyptians is admirably exemplified by their attitude towards astronomy. The celestial world above them stimulated their imagination, and produced a mass of myth and legend neither more nor less crude than that of any other early people. But since the study of the stars had no obvious connection with everyday life it attracted little attention and no real science of astronomy ever developed in Egypt. The positions of the stars were noted and they were arranged into constellations. It is now held, with considerable probability, that the tables of stars depicted, partly for ornamental purposes, on the roofs of the tombs of Rameses VI. and IX. at Thebes were used for measuring the lengths of the hours of night. A map is given for every fortnight of the year. Each map consists of a representation of a seated human figure, and for each hour of the night the position of some conspicuous star relative to that figure is given. The figure doubtless represents one of two observers seated on a temple roof or other flat place, one at each end of a north and south line. One of the two watched the movements of stars above and behind the other and, by reference to his star table, called the hours at the proper moments. This system, however, valuable though it might have been made with the help of an accurate water-clock (the Egyptian water-clocks were incorrect) seems to have given no more reliable results than the shadow-clocks used for measuring the hours of day, and the evidence appears to show that the problem of dividing a period of time into equal lengths remained unsolved.

In all the writings and inscriptions which have come down to us, historical, scientific and literary, there is no evidence of any kind of speculation as to the nature, size or position of any of the heavenly bodies, or as to the causes of their apparent movement: there is no hint that the Egyptians ever suspected that the sun and moon belonged to the same class of phenomena.

The observation of the heavens was not, however, entirely futile. Egyptian buildings were for the most part strictly orientated by the four points of the compass, and this was achieved by taking a bearing on the Pole star of that period whose immobility

must therefore have been observed, as was also the fact that a group of stars in its neighbourhood never disappeared below the horizon, for they were called "those which are never quenched." The approximate length of the year, too, had been obtained at a very early date, possibly before 4241 B.C., by observation of the heliacal rising of Sirius or Sothis, but such were the limitations of the scientists of that epoch that they failed to observe, or at any rate to allow for, the fact that this rising every fourth year took place after an interval of not 365 but 366 days, and that consequently their year of 365 days was about a quarter of a day short. Hence the disasters of the Egyptian Civil Calendar (*see* article CALENDAR, *Egyptian*).

There is nothing, therefore, to show or even to suggest that the cause of any single movement in the heavens had been discovered or even surmised, or that any celestial event was ever predicted on other evidence than the fact that it had happened before on the same date or in the same circumstances. In other words regularity had been observed, but causation, even if suspected, had not been investigated.

II. **Mathematics.**—In a country where landmarks were liable to be eliminated yearly by the flood, geometry must early have been a civil necessity, and the marvellous accuracy of construction revealed by the earliest pyramids shows us that as early as the Third Dynasty, say 2700 B.C., the Egyptians were masters of measurement in two and in three dimensions. A number of papyri, notably the Rhind, the Moscow and some fragments from El-Lâhûn give us a very clear picture of the powers of the Egyptian mathematician. These papyri contain nothing of the theory of mathematics but are collections of examples worked out, with the occasional intrusion of tables. The mathematical system which they reveal may be shortly described as follows:

The notation was decimal; one stroke stood for 1, two for 2, and so on up to 9. Ten was represented by a sign shaped like an inverted capital U, 20 by two such, and so on up to 90. There were separate signs for 100, 1,000 and each power of 10 up to 1,000,000. The defect of this system, apart from the lack of any positional notation, lay in its clumsiness, for to write 999 no fewer than 27 signs were needed, and even the ink-written script with its shortened forms did not entirely remove this defect.

The Egyptians were experts in the use of fractions, even those with large denominators, but subject to one limitation, namely that the numerator must always be 1. As multiplication was virtually limited to the multiplier 2 the only difficulty that could arise in multiplying fractions was that of dealing with twice an aliquot part (*i.e.*, twice a fraction whose numerator is 1). To meet this, a series of tables was formed in which the double of each odd aliquot part ($\frac{1}{5}$, $\frac{1}{7}$, $\frac{1}{9}$ etc.) was resolved into the sum of two or more aliquot parts, *e.g.*, twice $\frac{1}{7}=\frac{1}{4}+\frac{1}{28}$, twice $\frac{1}{19}=\frac{1}{12}+\frac{1}{76}+\frac{1}{114}$.

The only exception to the rule that fractions must have unity for their numerator is $\frac{2}{3}$, which to the Egyptian mind was oddly enough more fundamental than $\frac{1}{3}$, for this was obtained by first taking two-thirds of the required number and then halving it.

Addition and subtraction are both fundamental processes of counting and the Egyptians found no difficulty with them, even when the numbers involved were very large. Multiplication, however, was a more difficult operation, for the Egyptian learned only the 2-times table and not up to 12-times as we do. In other words, he could only double. Thus to find five times a number he had to double it, double the result, thus getting four times, and then add on the original number. Division was merely the reverse of multiplication. To divide 13 by 4 we start with 4. Doubling it we get 8, and by adding 4 we get 12, showing that 3 times 4 makes 12. This is just 1 short of 13, and since 1 is $\frac{1}{4}$ of 4, the answer is $3\frac{1}{4}$.

Apart from 2 no multiplier was used except 10, multiplication by which was automatic, inasmuch as one had only to change the units-signs to tens-signs, the tens-signs to hundreds-signs, and so on.

With these simple means the Egyptians proved themselves capable of dealing with such problems of every day arithmetic as came up for solution. The papyri give us examples of the division of bread among various numbers of men, of simple exercises in proportion and of the solution by trial of equations of the form $x+\frac{x}{a}=b$. The conceptions of squaring and square root were both known, and technical terms for them existed. The Rhind Papyrus has two problems in arithmetical progression and one in geometrical.

In two dimensional space the determination of the area of the square and the rectangle cannot be regarded as problems, for they involve nothing more than the conception of square measure. But the Egyptian had gone further than this, for he had correctly solved the area of the triangle. His approximation to the area of the circle was a good one, for he squared eight-ninths of its diameter.

In the geometry of three dimensions the volume of the parallelopiped follows at once from the very conception of three dimensional units, and that of the cylinder as the product of the area of the base into the height involves very little more. In determining the latter the error in the value of π was of course repeated. A much more brilliant feat was the correct determination of the volume of a truncated pyramid by the formula $V=\frac{h}{3}(a^2+ab+b^2)$, where h is the height and a and b the sides of the upper and lower squares of section respectively.

Several problems deal with the slope of pyramids. The angle is measured by its cotangent, *i.e.*, the vertical height is divided by half the side of the square base. Here too the practical interest of the mathematician is uppermost, for in the ratio thus found the first term is reduced to one cubit (or "forearm," 20·6 inches) and the other term, let us say 4 handbreadths, is given as a practical instruction to the stone-dresser, who has only to measure a cubit up and 4 handbreadths horizontally to get the correct slope of each block he has to dress.

III. **Medicine.**—Until a few years ago, when the Edwin Smith Papyrus was re-discovered in New York, Egyptian medicine was regarded rather as a department of magic than as a science. This was inevitable, for in the five or six medical papyri then known to us much less importance seemed to be attached to the remedies employed—though some of these doubtless had their efficacy—than to the magic spells and gestures by which the administration of the medicine was to be accompanied. Some of the recipes consisted wholly of spells, and in one papyrus the scribe had not even troubled to insert the quantities of each substance in the prescriptions. The arrangement of the contents of the papyri, too, seemed chaotic and unintelligent, and of the *materia medica* much was manifestly magic in origin, *e.g.*, milk of a woman who has borne a male child, while much was clearly chosen on the principle of "the filthier the more efficacious," *e.g.*, the excrement of flies or the blood of mice.

In the face of this evidence it is useless to deny that there existed a popular science of medicine in Egypt which, while conversant with the beneficial effects of certain drugs (unfortunately not many of the plant names are recognizable to us), was so thickly overlaid by magic as almost to forfeit the name of a science.

That there was something more to be said for Egyptian medicine than this, however, was already suggested by a description in the Ebers Papyrus of a system of "vessels" in the body, leading from the heart to the various organs, conveying air, water, blood and other substances. Their failure to function correctly was one of the causes of disease, and the treatment aimed at cooling, quieting, renewing or checking their activity by means of drugs. The more scientific attitude here observed is also to be found in the new Edwin Smith Papyrus, the full publication of which will undoubtedly raise our opinion of Egyptian medicine. The treatise is arranged in regular order, working from the head downwards, and deals chiefly with the surgery of the bones and outer tissues. It arranges its cases systematically under the headings of name of the complaint, examination, diagnosis and verdict. The explanatory notes which accompany some of the cases show a quite remarkable skill in studying the exact nature of a lesion and a genuine curiosity as to precisely what has happened to

[illegible] the same document written in part by the same hand. Firstly a spell for "driving out the evil of a year of plague" and secondly a book of spells for transforming an old man into a youth of twenty." What is to be made of so quaint a juxtaposition? It would seem as if side by side with the traditional popular medicine (old remedies richly tinged by magic, there existed a science practised by men who were not without interest in the problem of disease and injury for its own sake. At the same time it may not be a mere accident that of the medical literature which has come down to us at least four-fifths is of the popular, not the scientific type.

In conclusion it is clear that in a descriptive article of this kind it is necessary almost completely to ignore chronological perspective. The harm done in this case is the less because everything seems to indicate that Egyptian science attained its full growth in that period which was responsible for nearly every good thing which the country produced, namely the Old Kingdom, roughly 4000 to 2500 B.C. Not only do the medical papyri sometimes claim to give recipes known in the days of some king of that epoch, but the grammar of both medical and mathematical papyri is so archaic as to leave no doubt that some of their contents must have been derived from documents of that age. Egyptian tradition itself recognized the early origin of much of its scientific lore when it made Imhotep, a vizier of King Zoser of the Third Dynasty, the father not only of the art of architecture, but also of the science of medicine.

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RELIGION

We have now no grounds for holding the opinion that the educated Egyptian priest, far less the man in the street, normally accepted any pious theories of a latent *monotheism* underlying his blatant polytheism. Abnormally one particular school of priests may have done so for a time—the school of On or Heliopolis—where Ra' the sun-god does seem to have been raised from a henotheistic position to one closely resembling monotheism, until in the reign of Amenhotep III. it probably developed the completely abnormal true monotheism of the worship of the *Aten*, or Sun's disc, the heresy officially established by his son Ikhnaton, but thrown to the winds soon after the death of the latter. So abnormal was this monotheism that the Egyptians would have none of it: Ikhnaton was branded as a "criminal," and the Egyptians, who had, of course, in reality never abandoned it for a moment, returned joyfully to the cheerful polytheism of their ancestors, in which they continued to believe till the coming of Christianity. The educated Egyptian of the best period possessed the conception of "the divine," but not of "the One God"; he could see Godhead as such, but it was manifested in many gods; there was never only "One God" except the Aten, and his glory was but for a day. The nearest approach to monotheism was when one particular god was venerated henotheistically at one time, another at another.

Polytheism was of course the natural ancient belief of the Egyptians. It arose from the complicated fears of the Divine and rituals to propitiate it, and in Egypt more especially bears all the marks, in its complicated cults and rituals, of its savage origin. And naturally the further we go back the more complicated, the more self-contradictory, the more ritualistic and the more barbarous it is, as is the case among all nations. Some simplification was effected by the growth of the national intelligence, which by the time of the 18th dynasty really had evolved religious texts and hymns of a lofty character, that reach their acme under the supremely intelligent but unhappily reckless reform of Ikhnaton. To be so r[illegible] was to court disaster, even i[illegible] tainly nobody but a Pharaoh ha[illegible] such a revolution, nominal as [illegible] back to the old spells and mu[illegible] the Saite age comparatively [illegible] the reflection of whose though[illegible] extent in the rationalizings of [illegible] Under the Romans Egyptian [illegible] mire, till its death, prolonged b[illegible]

BY COURTESY OF THE METROPOLITAN MUSEUM OF ART

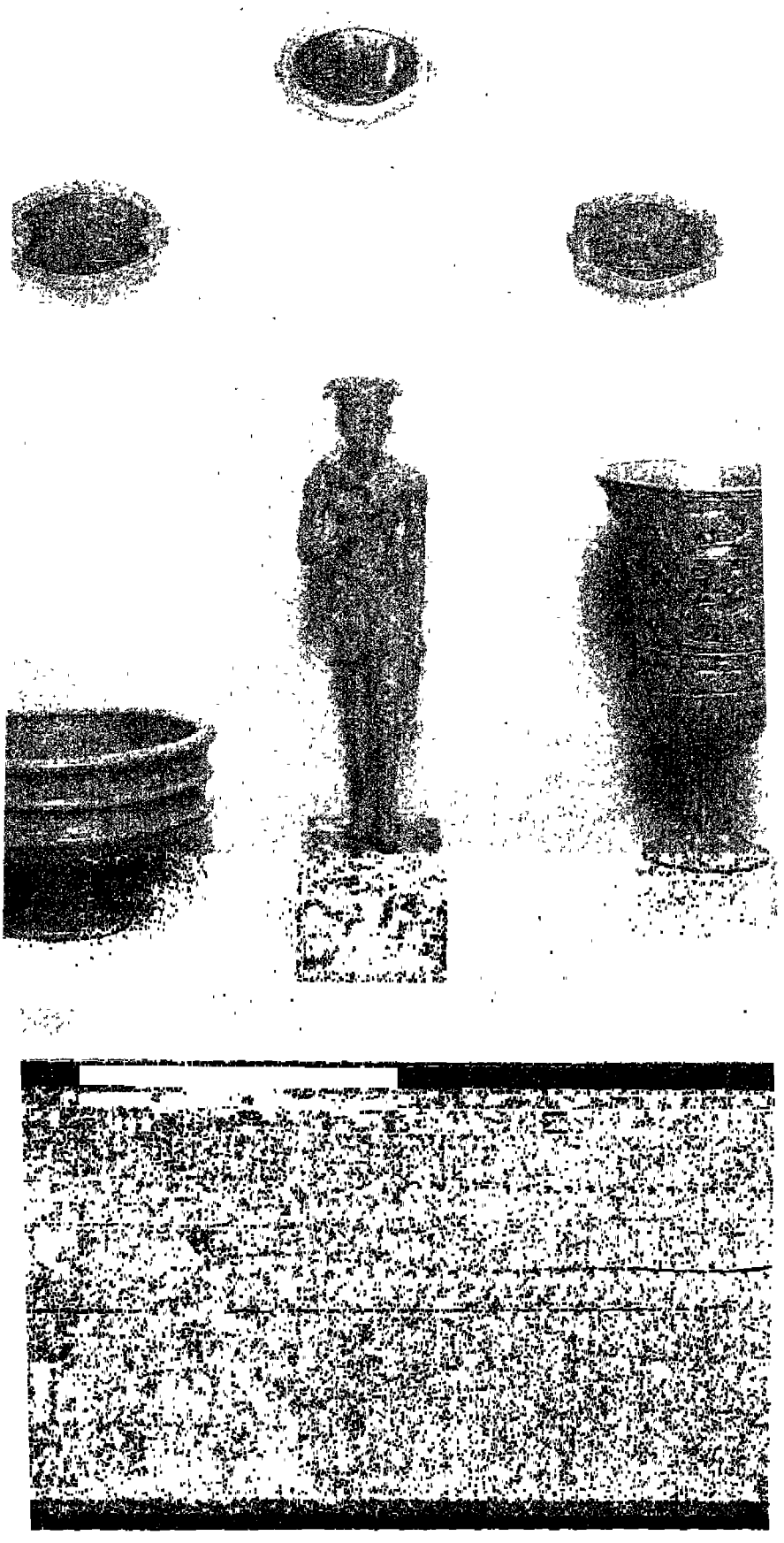
HEAD OF THE GOD AMON, FROM A STATUE ERECTED IN AN EGYPTIAN TEMPLE DURING THE 18TH DYNASTY

these mysteries enshrined truth[illegible] "faith" behind them. There [illegible] the case of the Ashantis or [illegible] Europe, that is all, and we have [illegible] are now. However, educated [illegible] Isis with contempt; only illite[illegible]

The Pantheon and its Ch[illegible] of the gods is of course Osiri[illegible] (Harpokrates), the family trio[illegible] later times they seem almost to[illegible] identified with many other gods[illegible] been an agricultural deity of [illegible] with the conquering dynastic [illegible] at Mendes, where he seems to [illegible] animal, the goat, if he did not [illegible] manner for which various expl[illegible] on became identified with two [illegible] Sokri, and the bull Hapi (Ap[illegible] under the middle kingdom wit[illegible] amentiu ("Chief of the West[illegible] Osiris-Khentamentiu becomes [illegible] the underworld of the tombs i[illegible] fashion, and every Egyptian be[illegible] Identification with the sun in [illegible] underworld followed. At Mem[illegible] Osiris, was confounded with th[illegible] (Socharis), and the bull Apis w[illegible] Osiris-Apis was graecized as Se[illegible] karah was also called *Se-n-H[illegible]* nection with Sinope in Asia M[illegible] expelled from the minds of cla[illegible]

Presumably Isis came from [illegible] well known legend of the findin[illegible] chest by her after his murder [illegible] She, like him, was human-hea[illegible] sonable to suppose that all the [illegible] extra-Nilotic northern origin, [illegible] of the primitive Nilotes. Certa[illegible] of Memphis, has a Semitic na[illegible] mummified: and if the *primiti* [illegible] a god he would presumably be [illegible] ing Osiris, Ptah, Amon, Min, [illegible] extra-Nilotic; Thoth, Hathor, [illegible] heads Nilotic. It is unwise to [illegible] possibility that though the

EGYPT



D CENTRE PANELS) THE METROPOLITAN MUSEUM OF ART, NEW YORK, (BOTTOM PANEL) THE BOSTON MUSEUM OF FINE A

EGYPTIAN HANDICRAFT OF 1580–1200 B.C.

es, *XVIIIth dynasty, from* bracelets or armlets, of King Amenhotep III (1411–1375 B.C.) o namented with scenes om he k ng's life dark sard s name ed p e ead work w th nx h d g be ore t s he bear ng he God set g is m de n Cen e Turquoise blue glass vase found at Thebes, XVIIIth dynasty; the god Amon, in the likeness of King Thutmose B.C falcnde up n the form of a otus flower o re of X X h–XXth dynast es Bo m Wooden oc h erog yph c s d symbo fig es re s g to th the wor d the dead

od o her own the ther olatry of the nation was ne r nven on and hat hev added he sacred an mals to the p rapher nal a of the gods whom the ne wcomers brought with them.

These "sacred animals" were of course more than this. They were, in the eyes of the people, themselves more or less gods: any ibis or ape *was* Thoth, in a sense, Thoth the god of intelligence walking about and as ibis inquisitively looking for things to find out with his long bill, or as ape weirdly, divinely, parodying the ways of men and acclaiming the coming of the sun-god at dawn with jubilant cries. Every bull on the contrary was not Apis, who had to have special marks; but a genuine Apis-bull was very much himself the god Ptah-Socharis. Every scarab-beetle was not of course itself the sun in the form Khopri, but as the *type* of Khopri (the roller, shaper, becomer, self-creator) partook of the divine nature of the sun-god and was mummified as much as an Apis. We all know Herodotus's story of the unlucky Greek who killed a cat, and as cats were generally mummified, like Apis-bulls, scarabs and ibises, it is probable that every she-cat, at any rate, was regarded more or less as Bubastis herself. The tale of the furious war between the Ombites and the Tentyrites, because one town had killed the crocodile that the other venerated, was one that always amused the Romans. Such contradictions were of the essence of Egyptian religion. Ombos in Upper Egypt, and one or two other towns in the north had the doubtful honour, in the eyes of other Egyptians, of worshipping Setesh or Set, the evil principle (so the others said), who was represented with the head of an animal that was a cross between those of a donkey and a pig—Set, the murderer of Osiris, whom Horus slew. And here we meet one of the first major inconsistencies of Egyptian religion, for the Horus who slew Set was not really Horus the son of Osiris at all, but quite a different and in reality far older Horus, the hawk-headed sky-god of Upper Egypt, worshipped at Edfu, who was often known as Haroëris, "Horus the Elder," to distinguish him from Harpokrates, "Horus the Child," who was the son of Osiris. Yet no doubt most people believed them to be both the same and different at the same time.

With the elder Horus we reach the group of hawk- or falcon-headed deities who are naturally, gods of the sky, of the sun too, and of the moon. Hawk-headed is Ra' or Rī' the sun-god, in early days the most venerated god, especially under the 5th and 6th dynasties. And he is never human-headed, whereas Horus (no doubt by confusion with the other Horus) sometimes is. But another sun-god, Itum, venerated at Heliopolis, and generally regarded as the setting sun, is always human-headed. Perhaps he was a Syrian and the hawk Ra', identified with him under the old kingdom, the old Nilotic sun-god. He was so closely identified with Ra' that the latter alone was often regarded as the Heliopolitan god. The rising sun was another form of the sky-god Horus, hawk-headed, and combined with Ra' as Ra'-Horakhti ("Ra' on the two horizons"), Ra-Harmachis. There was properly speaking no female of Ra' (as a Ra't, occurring in later times, was a pure invention in imitation of Isis), nor was there of Horus, unless the cow-headed Hathor ("House of Horus") can be so regarded: at any rate she was clearly connected with Horus in Upper Egypt as her name shows. She was the goddess of the deserts, and at Thebes a form of her, the snake Mersegret, protected the desert tombs. Sekhmet ("Power"), the lioness-headed, might be regarded as a female Ra', but she is always described as the consort of Ptah: Bastet or Bubastis, the cat-goddess was a northern Hathor, and like her also by some twist of thought was the patroness of love, of matters feminine and of fashion. Like her she has no official consort, as Sekhmet has. To Ptah and Sekhmet are later given, when somebody tried desperately to introduce logic into the "system," a deified human being, a historical personage turned god, Imhotep the sage, prime minister of King Zoser of the 3rd dynasty, who was naturally venerated at Memphis, the city of Ptah. Another late-deified prime minister, Amenhotep, son of Hapu (Amenothes, son of Paapis), was not so assigned, but in revenge he seems in Roman days to have been confused with Amen, the king of the gods, himself!

Under the Theban [illegible] dynasty, the local god of Thebes, Amon ("the hidden one"), a form of the ancient local god Min, and like him human-headed but unlike him not ithyphallic, came to the front, and with the establishment of the imperial power of the 18th dynasty at Thebes he took place as Amon-Ra' *Suntĕru* (Amonra-sonthĕr), "the king of the gods." This place he held nominally till the end, but was not much venerated outside Thebes after the close of the imperial period. In late times he seems often to have been confused with Osiris. He had a wife and son, like Osiris, Mut ("Mother") a local goddess of Thebes and Khons a local moon-god, who rarely appears at all till the 20th dynasty, and then much resembles Harpokrates, with whom in later days he was often confused. He was hawk-headed at first, like Munt, the war-god of Hermonthis, a little further south, a form of Haroëris (?). But later Khons was boy-headed, with the sidelock of youth, like Harpokrates. At Thebes was also venerated the well known hippopotamus-goddess Opet, called often Taueret (Thouëris, "the great one"), whose yearly festival was the greatest in the year at Thebes. Mut's animal was the vulture, Amon's the ram with curved horns. Further south, at Elephantine, was venerated Khnum the potter, ram-headed with twisted horns, a great god even till the very latest days. Onhur (Onouris), a human-headed war-god, was also Upper Egyptian. The ithyphallic Min, already mentioned, was the local god of Koptos, and was the deity of fertility.

The great god Dhuti or Thoth, never human-headed (and never ape-headed with a human body, when he is always ibis-headed), the patron of learning letters and intelligence, was one of the major deities, and was worshipped universally, but locally was the god of Hermopolis (Ekhmunu, Ashmunain). The Greeks called him Hermes as the *psychopompos*, since, by association with the Osirian cult, he ushers the dead into the presence of Osiris to be justified, naturally as he was the god who knew how to write and could record their names on his scroll. Even more closely associated with Osiris at Abydos is Anubis, the jackal-headed, originally the same as the local dead-god, Khentamentiu, and deriving his head from the desire to placate the jackals that ravaged the necropolis in the desert: wherefore the jackal was worshipped. In later days Anubis is called a son of Osiris, and is often confused with the very similar Ophois (Upuaut), the wolf-god of Siut (Lykopolis). A foreign importation (from Babylonia early in the middle kingdom) is Bes, the grotesque bearded man who became a patron of jollity and of luxury and fashion; ending as the *Silen* or satyr of the Greeks. Other (later) foreign importations are such purely Semitic deities (all of course human-headed) as Reshpu (Resheph), Baal and Anaita or Kedeshet, or Nubians like Maahes (lion-headed). Baal was often confused or identified with Bes.

Other deities to be mentioned are Hapimōū, the Nile-god, Neith, the war-goddess of Sais in the Delta, very prominent naturally in Saite days, Harshafit (Arsaphes), a ram-headed war-god worshipped at Herakleopolis Magna (Ahnas), among local gods; Shu the wind-god, Nut a sky-goddess and Geb the earth-god among purely cosmogonic deities (who received little or no worship); Ernutet (Thermouthis) the goddess of childbirth and of crops, Nepri the corn-god, and Tait the goddess of the funerary vestments, among miscellaneous minor deities; and deifications of qualities or forces (rather in the Roman fashion), like Ma'at the goddess of law and right (well known with her ostrich-feather, the symbol of justice), and Shai or destiny.

The Sun-disc or Aten was not represented by the Atenist heretics in human or animal forms but simply as the solar disc from which spread to the earth below rays ending in human hands holding the ☥ or symbol of life (*'ankh*), thus symbolizing the sun's gift of life to the world. This worship of the physical sun (or perhaps of a god behind the sun) as the giver of life was an eminently simple and rational one, but far too much so for the Egyptians, who, like other people, preferred irrational "mysteries" to such rational simplicity.

Lower than deities were various *genii* or demons like the Four Sons of Horus,—the human-headed *Mesti* the hawk headed

[illegible] ("Pleaser of his brethren"), the jackal-headed Duamutef ("Praiser of his mother") and the ape-headed Hapi, whose heads are found as lids on the four "canopic" jars in which the viscera of the dead were placed in the tomb. Here also lesser jackals and apes are given the post of honour among divine beasts. Elephants, deer, antelopes, owls and many other animals have no divine attributes, even the lion is rare as a divine head and is always very late (Horus) and provincial (Nubian: [illegible] and Mihes). There existed, however, some rather holy beasts, like the crane or "phoenix" (*bennu*) venerated at Heliopolis. The imaginary sphinx or human-headed lion was divine in so far as it was an image typifying the king as Horus. It should be noted that the Egyptian sphinx (including of course the great sphinx at Gizeh) is male: there were no female sphinxes in Egypt till Greek times. *See* SPHINX.

These deities were worshipped in their temples throughout the land: contemplar gods were common. Of rites and ceremonies we have a considerable idea. Lustrations of water were common, sacrifices consisted in simple offerings of meat, honey, oils, fruit and flowers: burnt-offerings were un-Egyptian. Incense was an universal offering and a most ancient one, as its name (*snutri*, "that which makes divine"), shows. The use of incense probably came to Egypt from Asia in very early days. The censer was fixed at the end of a long arm which was waved in the air, the swinging censer being unknown till Christian times. Musical instruments such as trumpets, and above all the sistrum (see *Music*) were employed in the ritual, also singing by the priestesses.

Priests did not really form a totally distinct caste, as Herodotus said, but they were an important and influential body from the time of the 18th dynasty, when the priesthood of Amen-Ra' at Thebes, to whom the conquered lands of Asia were largely assigned in fee, became enormously wealthy and powerful. In early days they were not so distinguished from the rest of the better class. We know the titles of the various orders of priests and their functions. High-priests often bore ancient titles, such as the "Great Chief of the Artificers" (*Uer-kherp-hemtiu*), the high-priest of Ptah at Memphis or the "Great Seer" (*Uer-maa*) at Heliopolis. Of the subordinate ranks of the "Pure Ones" (*uēbu*), there were *iotu-neter* or "divine fathers," *hemu-neter* ("prophets of the god"), "hour-priests" and the *khrihabiu* or "cantors" and the *Inmutf* and *Sem* who were connected with the service of the dead, and were often not regular priests but relatives of the deceased who assumed priestly functions for the occasion, in order to carry out the ceremonies at the tomb. Lay "tertiaries" connected with the services for the dead were called "hearers of the cry" (*sedjem-'ash*) in the Necropolis. The priestesses were generally known as "singers" (*shem'a*): they also shook the sistrum, which was a woman's instrument, in processions and dances. Magic dances were usual, and we have ivory wands which were used on them, on which are engraved the figures of various demons of the underworld. Magic was of course not separated from the religion, which was after all basically magical. There were no doubt degrees of magic. The word for magic or incantations, sorcery, etc., was *heka* or *hike*, which is not impossibly the origin of the name of the Greek demon goddess Hekaté.

Such things as scriptures and service-books we know little of. As has been said fine hymns were chanted to the sun-god under the 18th dynasty, and Ikhnaton's hymn to the Aten is famous for its resemblance to the 141st psalm (see *Literature*). But most of the religious writings were confined to the unintelligible spells of the so-called *Book of the Dead*, or "Book of Coming Forth by Day" (as the Egyptians called it), and such more sensible later developments of it as the *Book of the Underworld*, the *Book of the Gates*, and the *Book of Breathings*. All these were, so to speak, guide books to the next world for the use of the soul, devised to warn him of the dangers he might expect to meet and to provide him with powerful spells to guarantee his safety. These spells are most barbarous and least intelligible when we first meet them, in the "Pyramid texts" inscribed in the pyramids of the kings of the 5th and 6th dynasties. They seem to have been devised first for the protection of the king alone, afterwards being extended in use to the nobles and the mass of the nation. As time went on such magical care for the welfare of the dead originally in all probability reserved for the ruler and his entourage only, became available for all, as the worship of Osiris spread, and almost the humblest came to be regarded in death as much Osiris as the king himself.

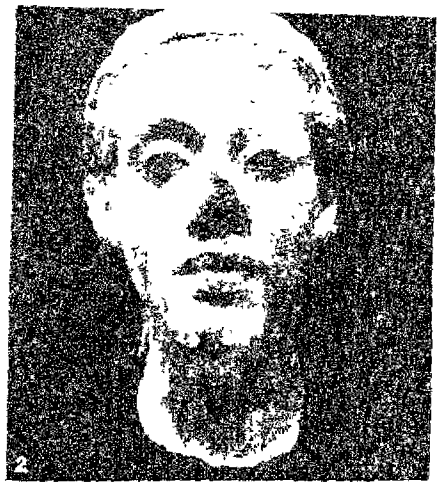
The preservation of the body was also no doubt originally a royal prerogative. This custom spread to the subjects with the other devices to ensure safety to the dead man. Originally the bodies of the dead no doubt dried fortuitously in their graves in the desert sand: some may have been smoked. It was seen to be possible in Egypt to preserve the dead from dissolution, and gradually the practice of mummification grew up, that was not really fully developed till the time of the 18th dynasty. (*See* MUMMY.) Middle Kingdom mummies are very lightly dried and often nothing remains but the skeleton. But they were swathed in bandages and elaborately buried in great rectangular wooden coffins with models of ships, labourers at work, etc. The course of mummification from the 18th dynasty to the 26th followed a regular course of development: it is possible to tell the dynasty to which a mummy belongs by the style of bandaging and embalming even when the name and titles have disappeared from the coffin. Human-headed coffins are characteristic of this period, in which the *Ushabtis* and *Canopic Jars* appear commonly. (See *Archaeology*.) Under the Saites Herodotus gives us his well known description of the three methods of embalming in use in his time, which it is unnecessary to repeat. The chief process was the steeping in natron or soda. He adds the interesting detail that the incision in the abdomen, through which the entrails were removed, was made by a special priestly official, the *paraschistes*, who made the cut with "an Ethiopian stone," and then fled away, pursued by (ceremonial) stones thrown at him. The "Ethiopian stone" was evidently a flint knife. Stone sarcophagi first appear under the 18th dynasty, and are specially heavy under the 26th, when two or three inner coffins of wood fitted one inside another, were usual for great people. Sacred animals, like the rams of Khnum and the Apis-bulls, were similarly embalmed and buried, the sarcophagi of the bulls in the Serapeum at Sakkarah being of enormous size and weight.

Tombs develop from the plain desert graves of the pre-dynastic period into brick structures in the case of the kings at the beginning of the 1st dynasty, which by the 3rd have developed into the *Mastaba*—or "bench" type—with chambers above ground and its deep pit, at the bottom of which is the actual tomb-chamber. These upper chambers are ornamented under the 4th with reliefs (see *Art*): the royal tombs have developed into the Pyramids (*q.v.*). Under the 6th dynasty another form of tomb appears in the south: chamber-tombs with a pit cut in the face of a cliff. This type is common under the Middle Kingdom. Owing to the steep shape of the Egyptian hills there is not much in the way of a dromos, which alone was marked by the pyramid-crowned chapel outside. Under the 18th dynasty we have at Thebes the characteristic tombs of Shaikh 'Abd al-Kūrna, with their pillared and painted galleries, and their stelae and statues of the deceased, while the kings have their sepulchres in the valley of the Bibān al-Mulūk, cunningly concealed, with long tunnels of approach cut in the hill, with all sorts of (necessary) precautions against tomb-robbers, and at end the vast excavated chambers in which the dead pharaoh hoped to rest amid his accumulated funeral pomp, buried with him. Actually only Tutankhamun, who was buried in a small unfinished tomb, has so survived till the present day, though the bodies of many of the other kings were found in *caches* to which they had been conveyed by later kings for safety's sake, and are now in the Cairo museum. In Saite times we have a return to ancient models in a sort of cross between a mastaba (brick built) with pylons (see *Architecture*), and a new empire tomb with columned chambers, which was very popular. The common people attained the privilege of mummification at this time, and in Ptolemaic and Roman days were buried in small graves or thrust into the ancient tombs of others in piles, one on the top of another. Ancient tombs, vacant or not, were the usual resting place of the better

RUSTEES OF THE BRITISH MUSEUM, (5) THE METROPOLITAN MUSEUM OF ART, NEW YORK, (8) THE MUSEUM OF FINE

AN FIGURE SCULPTURE FROM THE I. TO THE XII. DYNASTY

ydos, *one of the most precious relics* about 3200 B.C. 2. Cast of slate olis, 1st dynasty. 3. *Statue of Zoser* dynasty, about 2800 B.C. 4. Statue dynasty, about 2800 B.C. 5. Portrait -chambe of a tomb near G eh 4th dynasty, about 2700 B.C. 6. Obsidian portrait-head 12th dynasty, about 2000 B.C. *(from a cast)* 7. Gr *of Senusret III.;* Dair al-bahri, 12th dynasty. 8. Por Menkaure and his queen; Gizeh. 4th *dynasty* 9 A Hykos type, with portra -head of Amenemhet V h In the Saite period 8th century B C o later



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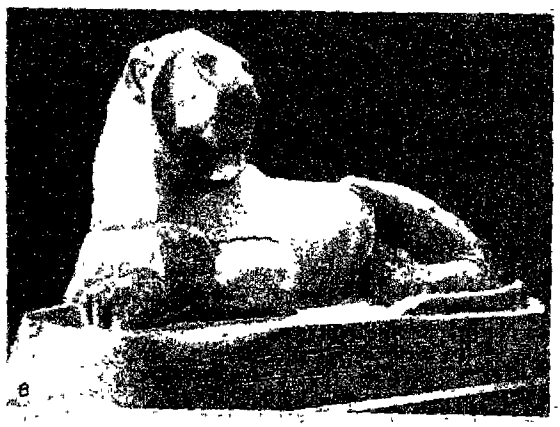

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OF (1, 2, 3) THE DIRECTOR OF STAATLICHE MUSEEN, BERLIN, (4, 6, 7, 8, 9) THE TRUSTEES OF THE BRITISH MUSEUM, (5

EGYPTIAN SCULPTURE OF THE XVIII. TO THE XXVI. DYNA

* Queen Nefertiti, queen of Ikhnaton (Akhenaton), 18th dynasty. e of sandstone, about 1 ft. in height; from Tel-el-Amarna. A vn now lost, made in a separate piece, was joined by the wedge shown (c. 1350)

it head of Amenhotep IV. (Ikhnaton), 18th dynasty, from Tel-marna, produced, it is thought, from an actual mask. Fillet on i was presumably to keep back hair in casting. There is a marked ence of modelling about lips and eyes

of one of the seven daughters of Ikhnaton; among discoveries of 0–11 at Tel-el-Amarna. The eyes were probably of inlay work. skull is artificially elongated

stic limestone statue of the 26th dynasty, imitating 5th dynasty k The arms placed close to sides, and the formal treatment of r are characteristic of the earlier period (c. 550 B.C.)

5. Head of portrait statue of Thotme found at Karnak. The face is i the representation of a conven

6. Kneeling statuette, 26th dynasty smile"

7. Sandstone head of a colossal sta from Thebes; height 3 ft. 10 one of the statues set up befor forehead, was a symbol of divin

8. Red granite lion, 18th dynasty placed in the Temple of Napat hamun restored the buildings

9. Head of statue of an official, in cr

cases now and were used over and over again. Mummification ceased in Christian days and Coptic mummies are not uncommon; good examples are in the Musee Guimet at Paris.

The beliefs of the Egyptians with regard to death were hopelessly confused, like those of most other peoples. The whole idea of the tomb seems originally to have been due simply to the passionate desire to deny the existence of death. "Oh ye living upon earth, who love life and hate death," begins the invocation to the living often inscribed on the tomb-walls. The Egyptians, a cheerful merry people, loathed the idea of death, and did their best to persuade themselves that the dead were not actually dead at all, but continuing to live in the underworld of the tomb in some weird fashion, and that their life there could be preserved by means of magical spells and the representations on the tomb-walls or in the shape of models of their ordinary life on earth. Then there was the idea of a sort of temporary "resurrection" of the dead, who were supposed to be able to "come forth by day" from the tomb by means of spells if they liked, or like Osiris (a confusion with his agricultural aspect), to live again as the grain sprang up again each season.

Then there was the idea that the dead lived with the gods, especially those of the underworld, and accompanied Khent-amentiu (Osiris), on his nightly rounds of his realm, as the dead sun. Again there was the idea of souls: the *ka* (*ko*) or double for whom, represented as a statue, a special house in the tomb was provided in early days; the *bai* or soul proper (a human-headed bird); the *ikh* or "spirit" (a bird); the *khaibit* or "shadow" and so on. The *bai* was supposed to be able to visit the *khat* or body in the tomb, but the *ikh* flew off to the heaven-gods in the sky. Then there was the idea of moral justification of the deceased, his "negative confession" in the ritual and the judgment by Osiris and his "42 Assessors" (which in the time of Herodotus was probably actually enacted by priests over the body of great people); the weighing of the heart by Thoth against the feather of Maat, and so forth, which marked the influence on the Egyptian mind of the Semitic idea of sin, originally foreign to it. We hear very little of moral ideas except in scholastic papyri (see *Literature*). Religion was primarily an affair of ceremonies and spells, intended to bring about certain desired results by means of the help of one or some of the multitudinous deities. Even the monotheist hymns to the Aten are not ethical. They merely praise the sun for his life-giving heat, there is nothing in them depreciatory of the moral character of the praiser, in Semitic fashion. The Egyptian was never a humble person, either genuinely or hypocritically. When he confessed he did not say "I am guilty", he said "I am not guilty"; his confession was negative, and the *onus probandi* lay on his judges who, according to the funerary papyri, always gave the verdict in his favour, or at any rate it was hoped and expected would do so.

The many-sided character of Egyptian religion and its manifold contradictions and deficiencies (human and straightforward enough), will be evident from the above description. What varying views on the subject can be held by writers of differing mentalities will be seen from a perusal of the works mentioned in the bibliography below, which partly consists of works with whose theses the present writer entirely disagrees, but which he quotes in fairness to their authors and to those readers who see things in the same light as they do. That they will leave a confused impression on the mind is only to be expected from the nature of the subject.

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(H. R. H.)

DEFENCE

Army.—The youth of Egypt was liable to be called upon for service in the field under the local chiefs. Their training consisted of gymnastic and warlike exercises which developed strength and discipline that would be useful in executing public works and in dragging large monuments, as in strictly military service. They were armed in separate companies with bows and arrows, spears, daggers and shields, and the officers carried battle axes and maces. The army, commanded in chief by Una under the 6th dynasty for raids in Sinai or Palestine, comprised levies from every part of Egypt and from Nubia, each under its own leader. Under the New Empire, when Egypt was almost a military state, the army was a more specialized institution, the art of war in siege and strategy had developed, divisions were formed with special standards, there were regiments armed with battle-axes and scimitars, and chariots formed an essential part of the host. Egyptian cavalry are not represented upon the monuments, and we hear little of such at any time. Herodotus divides the army into two classes, the Calasiries and the Hermotybies; these names, though he was not aware of it, mean respectively horse- and foot-soldiers, but it is possible that the former name was only traditional and had characterized those who fought from chariots, a mode of warfare that was obsolete in Herodotus's own day; as a matter of fact both classes are said to have served on the warships of Xerxes' fleet. (X)

The fellah soldier has been aptly likened to a bicycle, which although incapable of standing up alone, is very useful while under the control of a skilful master. It is generally believed that the successes gained in the time of the Pharaohs were due to foreign legions; and from Cambyses to Alexander, from the Ptolemies to Antony (Cleopatra), from Augustus to the 7th century, throughout the Arab period, and from Saladin's dynasty down to the middle of the 13th century, the military power of Egypt was dependent on mercenaries. The Mamelukes (slaves), imported from the eastern borders of the Black sea and then trained as soldiers, usurped the government of Egypt, and held it till 1517, when the Ottomans began to rule. This form of government, speaking generally, endured till the French invasion at the end of the 18th century. British and Turkish troops drove the French out after an occupation of two years, the British troops remaining till 1803. Then Mohammed Ali, coming with Albanian mercenaries, made himself governor, and later (1811), by massacring the Mamelukes, became the actual master of the country, and brought Arabia and Nubia under Egypt's rule. Requiring a larger army, he conscripted over 250,000 fellahin, and in so arbitrary a fashion that many peasants mutilated themselves to avoid the much-dreaded service. Nevertheless the experiment succeeded. The docile, yet robust and hardy peasants, under their foreign leaders, gained an unbroken series of successes in the first Syrian War; and after the bloody battle of Konia (1832), it was only European intervention which prevented the Egyptian general, Ibrahim Pasha, from marching unopposed to the Bosporus. The second Syrian War (1839), confirmed that it was possible to obtain favourable military results with Egyptians when stiffened by foreigners and well commanded. Ibrahim, the hero of Konia, declared, however, that no native Egyptian ought to rise higher than the rank of sergeant; and in the Syrian campaigns nearly all the officers were Turks or Circassians, and in the cavalry and artillery many of the privates were escaped janissaries.

Under Mohammed Ali's successors the army shrank to nothing, until Ismail who, succeeding in 1863, in seven years was able to put 100,000 men, well equipped, in the field. He conquered the greater part of the (Nile) Sudan; but an expedition to Abyssinia suffered disaster. The education of Egyptians in Continental cities had not produced the class of leaders who led the fellahin to victory at Konia. Ismail's exactions from the Egyptian peasantry reacted on the army, causing discontent; and when he was tottering on the throne he instigated military demonstrations against his own government, and by thus sapping the foundations of discipline, assisted Arabi's revolution; the result was the battle of Tell el Kebir, the British occupation, and the disbandment of the army, which at that time in Egypt proper consisted of 18,000 men. (*See* EGYPT AND SUDAN, CAMPAIGNS IN, 1882–1899.)

In January 1883, Maj.-Gen. Sir Evelyn Wood, V.C. was given

[illegible] ing a fellah [illegible] of [illegible] H [illegible] first b [illegible] 6 [illegible] Lieut. H. Kitchener R.E. Each battalion of the 1st infantry brigade had three British mounted officers, Turks and Egyptians holding corresponding positions in the battalions of the 2nd Brigade. The privates were conscripted from their villages. The earlier merciless practice had been in theory abolished by decree in 1880; but actually the 6,000 recruits represented the biggest and strongest peasants who could not purchase exemption by bribing the officials concerned. But the perseverance of British officers gave the oppressed peasants, in 1885, an equitable law, which was subsequently improved by the decree of 1902. General considerations later caused the sirdar to allow exemption by payment of (Badalia) £20 before ballot—part of this being expended in the betterment of the soldier's position.

The earlier efforts of 48 American officers, who under Gen. C. P. Stone zealously served Ismail, had failed to overcome Egyptian venality and intrigue; so that the task undertaken by the small body of British officers was difficult. That there had been no adequate auxiliary departments, without which an army cannot move or be efficient, was comparatively a minor difficulty. To succeed, it was essential that the fellah should be taught that discipline might be strict without being oppressive, that pay and rations would be fairly distributed, that brutal usage by superiors would be checked, that complaints would be thoroughly investigated, and impartial justice meted out to soldiers of all ranks. An epidemic of cholera in the summer of 1883 gave the British officers their first chance of acquiring the esteem and confidence of their men, and the regeneration of the fellahin army dates from that epidemic.

When the Egyptian Army of the Delta was dispersed at Tell el Kebir, the khedive had still 40,000 troops scattered in the Sudan. These were composed of Turks, Albanians, Circassians and some Sudanese. Ten thousand fellahin, collected mainly from Arabi's former forces, set out in September 1883, under Hicks Pasha, a dauntless retired Indian Army officer, to vanquish the Mahdi. They disappeared in the deserts of Kordofan, where they were destroyed by the mahdists about 50m. south of El Obeid. Baker Pasha, with about 4,000 constabulary, who were old soldiers, attempted to relieve Tokar in February 1884, but was attacked by 1,200 tribesmen and utterly routed.

It was then deemed advisable to rely on blacks to stiffen the fellahin—five Sudanese battalions being successively formed. But in the Gordon relief expedition of 1884 the Egyptians did remarkably good work on the line of communication from Assiut to Korti, a distance of 800m., and the honesty and discipline of the fellah were shown to be undoubtedly of a high order. By the time of the Omdurman campaign, 1898, the standard of honesty was unimpaired, and the British officers had imparted energy and activity into Egyptians of all ranks. The large depots of stores at Aswân, Halfa and Dongola could be supervised only cursorily by British officers, and yet when the stores were received at the advance depot the losses were infinitesimal.

By nature the fellah is unwarlike. Born in the valley of a great river, he resembles in many respects the Bengali, who exists under similar conditions; but the Egyptian has proved capable of greater improvement. He is stronger in frame and can undergo greater exertion. Singularly unemotional, he stood steady at Tell el Kebir after all his officers had fled. It has been aptly said "the fellah would make an admirable soldier if he only wished to kill some one!"

The well-educated Egyptian officer showed aptitude for regimental routine, and worked well when supervised by men of stronger character. The ordinary Egyptian is not self-reliant or energetic by nature. The black soldier has, on the other hand, many of the finest fighting qualities. Sudanese are very excitable and apt to get out of hand; unlike the fellahs they are not fond of drill, and are slow to acquire it; but their dash, pugnacious instincts and desire to close with an enemy, are valuable military qualities. The Sudanese, moreover, shoot better than the fellahin, whose eyesight is often defective. The Sudanese captain is slow but self reliant, and much respected by his men.

In 1908 the Egyptian army with a total establishment of 18,00[illegible] consisted of three squadrons of cavalry (one composed of Sudanese) four batteries of field artillery and a Maxim battery the camel corps 626 of all ranks (fellahin and Sudanese) and nine fellahin and six Sudanese infantry battalions, 10,631 of all ranks. The stringent system of selecting British officers, originated by the first sirdar in 1883, is shown by the fact that of the 24 employed in creating the army, 14 rose to be generals. Competition for employment in the army became severe and the service attracted the very best of the British Army. In 1908 there were also 140 British warrant and non-commissioned officers. (E. Wo.)

Modern Developments.—So matters rested, in the main, until the World War. This had a vital influence upon military developments in Egypt, of which the end is not yet in sight. On August 5, 1914, the Egyptian Prime Minister signed a document which amounted virtually to a declaration of war by Egypt against the enemies of Great Britain. The alternative would have been the disarmament or internment of the British troops in the country, a policy which could hardly be contemplated. By October the impending hostility of Turkey wrought a complete change in the situation, and it was found necessary to proclaim martial law. By that time the regular British troops had been withdrawn, their place being taken by Territorial units, and from thenceforward Egyptian territory became a base of operations for British, Australasian, Indian and other troops. The defence of the Suez canal became a matter of primary importance to the Allied cause, not only for economic but also for military reasons.

The tale is told elsewhere of attacks upon the canal by Turks with German aid and instigation, of raids by Senussi (*q.v.*) forces in the south-west and in the west, and of subsequent British offensive operations in Palestine (*q.v.*) and Syria, using Egypt as a base. Five days after war broke out with Turkey, Egyptians were informed by proclamation that they would not be called upon for assistance, but those who gave the pledge were proved to be lacking in forward vision. Only a few Egyptians, it is true served under arms in the defence of the Suez canal against Turkish invaders in 1914–15 but the resources of the country in man-power, in transport animals (especially camels), and in economic provisions were fully exploited to meet the ultimate needs of British empire armies. Returns of the effective strength of the Egyptian expeditionary force in November 1918 show that over 96,000 Egyptians were serving in the army, 88,000 of them being in labour units, and we find a mention of over 17,600 Egyptians described as being employed "in substitution for British personnel" (*Military Effort of the British Empire*, p. 161). There is little doubt that, without the aid of the Egyptian labour corps and the camel transport corps, the original British advance across Sinai into Palestine would have been more protracted, and the aid of these corps was invaluable during subsequent stages of the operations. Some statistics in connection therewith will be of interest, bearing in mind throughout that Egyptians as a whole did not grasp that the prosecution of a campaign in Palestine tended to their advantage. For a time the ranks were filled voluntarily, but ultimately, in the fourth year of the war, the Corvee had to be introduced again in order to obtain the monthly contingent required, which rose from 17,000 in May 1917 to 26,000 in June 1918. In the former month it was found necessary to disarm all Egyptian citizens, military considerations being held to over-ride political consequences. With these we are not here concerned, beyond mention of the disastrous effect of military measures upon the attitude of Egyptians to the British.

The Egyptian camel transport corps of the World War has been described as a unique creation which acquitted itself gloriously. 170,000 Egyptians served in this corps. Though working behind the lines, 220 of them were killed and 1,400 wounded by enemy action, 4,000 died in field hospitals. 72,000 camels were purchased from various sources for this corps; in 1917, 12,000 out of 65,000 male camels in Egypt were taken. The culminating effect of this and of other demands upon the agricultural and economic resources of Egypt was one of the factors that contributed to produce the unsettl[illegible] which led to the rebellion

of 1919, and culminated in the assassination of the British sirdar of the Egyptian army in November 1924. That event was followed in 1925 by the creation of a Sudan defence force, independent of Egypt, in place of the Egyptian army garrison. There are now therefore three military forces in Egypt and the Sudan, the British troops in both countries, the Egyptian army in Egypt and the Sudan defence force from Wady Halfa to the southwards

Present-day Army (Egypt).—The Egyptian army is recruited on a compulsory basis, but only a small percentage of the contingent reaching military age every year is needed for service in the army. Taking the year 1925 as typical, the number inscribed on the list was 153,879. After exempting 94,250 for various reasons, and eliminating the unfit, 14,363 were passed as fit for service, and of these only 1,462 were taken into the army (*Annuaire Statistique*. Cairo, 1926). Service is for five years with the colours and five in the Reserve. The total strength of the army (1928) may be taken at about 11,400. The organization is in the usual arms. Cavalry (two squadrons), artillery (four field batteries and one garrison company), and infantry (11 battalions) with the usual ordnance, supply and transport, and medical departments.

The king is head of the army, and there is an army council on the British lines, presided over by a minister. A British General officer, with the title of Inspector-general, carries out the functions appertaining to the post of sirdar. A few British officers occupy high appointments in the army staff. The various military formations and subordinate units are now commanded by Egyptians There are three brigade commands, the infantry and other arms being widely distributed; the battalion at Aswân is the farthest up the Nile. From Wady Halfa southwards troops of the Sudan defence force, recently formed, are to be found.

Sudan Defence Force.—In the regular troops of the Sudan defence force recruitment is voluntary, for three years with the colours up to six years for special arms of the service. Some of the units are still (1928) in embryo, so any estimates of total strength would be misleading. The 9th Sudanese battalion (at Omdurman) is the only survivor of the six battalions of Sudanese formerly in the Egyptian Army. The Sudan defence force includes, besides two battalions of British infantry, a camel corps with headquarters and a machine-gun section, two camel companies, one of mounted infantry, and four of infantry; an Eastern Arab corps containing one camel company and three infantry companies; a Western Arab corps, with three mounted infantry companies, one infantry company and a machine-gun battery; 12 companies of Sudanese reserves; an "Equatorial corps" with nine companies of infantry; and the usual departmental units, medical, ordnance supply and transport (mechanical transport forming a special feature in suitable country). With the exception of a section of guns in the Eastern Arab corps there is no artillery in the Sudan defence force. The whole force is commanded by a British General officer. For administration the British battalions are under the General officer commanding the British troops in Egypt. The subordinate commanders are British officers, a large proportion of whom served previously in the Egyptian army. The ranks which they hold in the Sudan defence force are Ferik (Major-general), Lewa (Brigadier-general or Colonel-Commandant), Miralai (Colonel), Kaimakan (Lieut.-colonel), Bimbashi (Major), Saghkolaghasi (Adjutant-major), Yuzbashi (Captain), Mulazim Awal (Lieutenant) and Mulazim Tani (2nd Lieutenant). The title of the General officer commanding is "Kaid d'Amm."

Besides the Sudan defence force there are mounted and foot police, most of whom have recently been armed with magazine rifles, replacing Lee-Enfield carbines.

The British troops in Egypt proper included in May 1928 one brigade (three regiments) of cavalry, two brigades (each of three battalions) of infantry, one brigade of field and one of light artillery, two field companies of engineers, three companies of signals, one section of tanks and one company of armoured cars (in process of transfer to the cavalry), besides supply, transport, medical, ordnance and veterinary units.

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ECONOMICS

For Egypt, the modern phase of its public finance began with the accession of the Khedive Ismail, and its story since then is a fascinating tale of the steps by which the country, after having been brought to a state of bankruptcy, passed through a period of great stress, and finally attained prosperity and a large measure of financial autonomy.

Public Finance.—In 1862 the foreign debt of Egypt stood at £3,292,000. The period of wild extravagance, reckless borrowing and merciless exploitation of the fellahin which ensued was the subject of a remarkable report by Stephen Cave, a well-known banker, who was sent by the British government in Dec. 1875 to inquire into the situation. It described Egypt in 1875 as being burdened with a debt of £91,000,000—funded or floating—for which she had no return, for even from the Suez canal she derived no revenue, owing to the sale of the khedive's shares. Soon after Cave's report appeared (March 1876), default took place on several of the loans. Nearly the whole of the debt was held in England or France, and at the instance of French financiers the stoppage of payment was followed by a scheme to unify the debt This scheme was blocked by the British bondholders, and its place was taken by another scheme drawn up by Goschen and Joubert, who represented the British and French bondholders respectively. That settlement in turn was superseded by the Law of Liquidation of July 1880,—equally short-lived, as events were to show. But out of all these attempts to secure solvency there remained two important results. One was the establishment of a Treasury of the Public Debt, known by its French title of *Caisse de la Dette*, and commonly spoken of simply as "the Caisse ' The duty of this body was to act as receivers of the revenues assigned to the service of the debt, and they were given the right to sue the Egyptian government in the Mixed Tribunals for any breach of engagement to the bondholders The other was the "Dual Control," the appointment of an Englishman and a Frenchman to superintend the revenue and expenditure of the country

The 1880 settlement was wrecked by the Arabi rising, the riots at Alexandria, and the events generally which led to the British occupation of Egypt in 1882, followed by the losses incurred in the Sudan in the effort to prevent it falling into the hands of the Mahdi. On the initiative of Great Britain a conference between the representatives of the great powers and Turkey was held in London, and resulted in the signing of a convention in March 1885. The terms agreed upon in this instrument, known as the London Convention, were embodied in a khedivial decree, which, with some modification in detail, remained for twenty years the organic law under which the finances of Egypt were administered

It divided the revenue of the country between the Caisse, as representing the bondholders, and the government, assigning to the service of the debt all revenue derived from the railway, telegraphs, port of Alexandria, customs (including tobacco) and from four of the provinces. It recognized, however, that the non-assigned revenue was insufficient to meet the necessary expenses of government, and a scale of administrative expenditure was drawn up. The Caisse was authorized, after payment of the coupons on the debt, to make good out of their balance in hand the difference between the authorized expenditure and the non-assigned revenue. If a surplus remained to the Caisse after making good such deficit the surplus was to be divided equally between the Caisse and the government. The Convention empowered Egypt to raise a loan of nine millions, guaranteed by all the powers, at a rate of interest of 3%. For the service of this loan —known as the Guaranteed loan—an annuity of £315,000 was provided in the Egyptian budget for interest and sinking fund The £9,000,000 was sufficient to pay the Alexandria indemnities, to wipe out the deficits of the preceding years, to give the Egyptian treasury a working balance of £E 500 000 and to pro-

one million for new irrigation works. To the wise foresight which, at a moment when the country was sinking beneath a weight of debt, did not hesitate to add this million for expenditure on productive works, the present prosperity of Egypt is largely due.

The provisions of the London Convention did not exhaust the restrictions which excluded the Egyptian government from financial autonomy. It was impossible, for example, to raise a loan without the consent of the Porte. Then it was not permissible, in virtue of the Capitulations, to levy taxes on foreigners without the consent of their respective governments. Again, no financial decision could be taken by the Egyptian government without the consent of the British official called the financial adviser, who in 1883 had replaced the Dual Control: though it is fair to add that this restriction long remained the chief safeguard for the purity of Egypt's finances. Finally came the series of commissions or boards known as Mixed Administrations and having relations of a quasi-independent character with the ministry of finance. Of these boards by far the most important was the Caisse. As first constituted it consisted of a French, an Austrian, and an Italian member: a British member was added in 1877 and a German and a Russian member in 1885. The revenue assigned to the debt charges was paid direct to the Caisse without passing through the ministry of finance. The assent of the Caisse (as well as that of the sultan) was necessary before any new loan could be issued, and in the course of a few years from its creation this body acquired very extensive powers. Besides the Caisse there was the Railway Board, which administered the railways, telegraphs and port of Alexandria for the benefit of the bondholders, and the Daira and Domains commissions, which administered the estates mortgaged to the holders of those loans. Each of the three boards last named consisted of an Englishman, a Frenchman and an Egyptian.

During the years that immediately followed the signing of the London Convention, the financial policy of the Egyptian government was the exercise of the most rigid economy in all branches; and in his report on the financial results of 1888 Sir Evelyn Baring (afterwards Lord Cromer) was able to inform the British government that the situation was such that "it would take a series of untoward events seriously to endanger the stability of Egyptian finance and the solvency of the Egyptian government." From this moment the corner was turned, and the era of financial prosperity commenced. The principal feature of the successive Egyptian budgets of 1890–94 was the fiscal relief afforded to the population. From 1894 onward attention was turned to the legitimate demands of the spending departments and to the prosecution of public works. Of these the most notable was the construction (1898–1902) of the Aswân dam, which by bringing more land under cultivation permanently increased the resources of the country and widened the area of taxation. At the same time various changes were made in connection with the debt charges. With the consent of the powers a General Reserve Fund was created in 1888, into which was paid the Caisse's half-share in the eventual surplus of revenue. This fund, primarily intended as a security for the bondholders, might be drawn upon for extraordinary expenditure with the consent of the commissioners of the Caisse. Large sums were so advanced for the purposes of drainage and irrigation and other public works, and in relief of taxation. Secondly, by manipulation of certain sections of the public debt, a Conversion Economies Fund was established, for the purchase and cancellation of Egyptian stock. A Special Reserve Fund had been constituted in 1886 and was very largely made up of the net savings of the Egyptian government on its share of the annual surpluses from revenue. Of the three funds this last-named was the only one at the absolute disposal of the government. The whole of the extraordinary expenditure of the Sudan campaigns of 1896–98, with the exception of £800,000 granted by the British government, was paid out of this fund—a sum amounting in round figures to £1,500,000.

The inherent wealth of the country now began to assert itself against the artificial shackles of its State finance. During the four years 1885–88, both inclusive, the aggregate deficit amounted to £E 2,606,000. In 1887 there was practical equilibrium in the budget, in 1889 there was a surplus of £E 218,000. In 1895 the surplus exceeded, for the first time, £E.1,000,000. The growth of revenue was no less marked, in spite of reductions and remissions of taxation. The fact that Egypt was suffering very severely from the general fall in the price of commodities during that period makes the prosperity of the country the more remarkable. Had it not been for the great increase of production as the result of improved irrigation and the fiscal relief afforded to landowners, the agricultural depression would have impaired the financial situation. As it was, a much-needed re-assessment of the land tax, which occupied from 1899 to 1907, coupled with the remission of arrears, had been a powerful stimulus to rural prosperity. The blighting influence of international control, however, persisted, and its net result was to impose an extra charge of about £1,750,000 a year on the Egyptian treasury.

Egypt Gains Financial Liberty.—Freedom at last emerged from the 1904 understanding between France and England. A khedivial decree of Nov. 28, 1904, a decree which received the assent of the powers, swept away a host of the old restrictions, and gave the Egyptian government a free hand in the disposal of its own resources so long as the punctual payment of interest on the debt was assured. The plan of fixing a limit to administrative expenditure was abolished. The consent of the Caisse to the raising of a new loan was no longer required. The Caisse itself remained, but short of all political and administrative powers, its functions being strictly limited to receiving the assigned revenues and to ensuring the due payment of the coupon. The nature of the assigned revenue was altered, the land tax being substituted for those previously assigned, that tax being chosen as it had a greater character of stability than any other source of revenue. By this means Egypt gained complete control of its railways, telegraphs, the port of Alexandria and the customs, and as a consequence the mixed administration known as the Railway Board ceased to exist. The Conversion Economies Fund was also placed at the free disposal of the Egyptian government and a new General Reserve Fund was created, made up chiefly of the surpluses of the old General Reserve, Special Reserve, and Conversion Economies funds. This new fund started with a capital of £13,376,000 and was replenished by the surpluses of subsequent years, while it provided large capital expenditure for remunerative public works. Advance was now possible simultaneously along the lines of fiscal reform and increased administrative expenditure. Thus in 1906 the salt monopoly was abolished at a cost to the revenue of £175,000, while the reduction of import duties on coal and other fuels, live-stock, etc., involved a further loss of £118 000, and an increase of over £1,000,000 in expenditure was budgeted for. In fact, from 1905 onwards it was practicable to draw up the Egyptian budget in accordance with the needs of the country and on sound financial principles. At the end of 1905 the public debt stood at £96½ millions, or at almost the exact figure it did in 1883, although by borrowing and conversion operations nearly £17,000,000 had in the meantime been added to the capital.

Since 1905 the public finance of the country and its material development have progressed hand in hand. Communications by road and rail have been rapidly improved, to the great advantage of the staple industry of cotton; and even more important has been the striking extension of scientific irrigation. The margin of cultivation in the Delta has been widely enlarged, 40,000 feddans south of Cairo have been converted from single to double crop production, and the 90,000 feddans previously in constant danger of being starved by a low Nile flood have been reduced to a negligible figure; all this being rendered possible by the construction (1902) and heightening (1912) of the Aswân dam, and the building of the Asyut (1902) and Isna (1909) barrages. It is the unremitting industry of the agricultural peasantry, stimulated by light and equitable taxation, by the establishment of a great measure of public security and economic freedom and by care for the public health, that has been the motive force turning these favouring conditions to such remarkable account. Private and public wealth was gradually built up thereby from impoverishment and bankruptcy, and provided funds which enabled the cul

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EGYPTIAN CARTONNAGES AND WOOD CARVINGS

n of Artemidorus. About A.D. 150

ood. 18 h dynasty c 1400 B C

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5. Carved wooden boat with rowers, from the furnlti dynasty c 2200 B.C

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EGYPT

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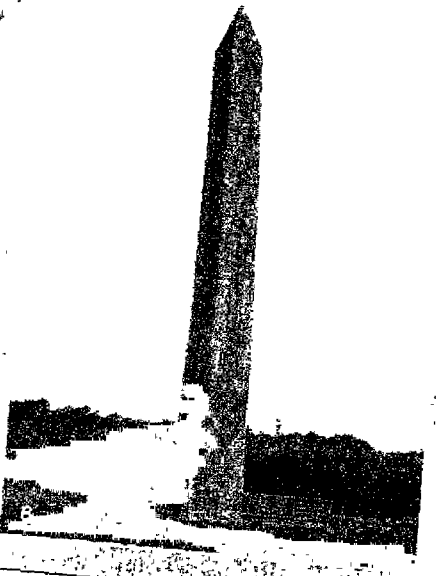

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APHS (1) EWING GALLOWAY, (2) PUBLISHERS PHOTO SERVICE, (3, 5, 6, 8, 9) DONALD McLEISH, (4, 7) ASSOCIATED SCRE

STREETS AND BUILDINGS OF ANCIENT AND MODERN

se in Cairo, showing type of window used for the harem, to ensure
2 Street in Gizeh, ancient Egyptian town near Cairo, on the
f the Sahara Desert. 3. Muslims at prayer in the court of the Abha
e Mosque, Cairo. 4. Bazaar quarters Cairo. 5 Curio shop the
Bazaar Cairo 6 Booksellers
Ca ro w th bu d ags of
ancient Arabian architecture. 7
constructed during the 18th and
Obel sk a Hel opo s one of a
2000 B C) 9 Ports at t
the pe pend cu ar nes is ohen

able area to be employed and a greatly increased population to be supported. The vehicle of advance was unquestionably cotton. In response to the world demand the price of Egyptian cotton increased greatly from approximately 1902 onwards, so that the country became rapidly enriched. This fortuitous accession of wealth led to a speculative boom, which was succeeded by a sudden and complete slump in 1907. The reaction left Egypt with a load of unproductive debt which constituted a new and heavy charge upon its prosperity. Between then and the World War two tendencies were in conflict. A succession of abundant cotton harvests realized at good prices tended to add steadily to the country's wealth, while the pressure of indebtedness seeking relief in further debt operated in the opposite direction.

The immediate effect of the outbreak of war was to reduce the price of cotton by a third and thus deprive Egypt at a stroke of the increased income it had enjoyed for some 12 years previously. The sudden diminution of the country's purchasing power reacted severely on economic activity, imports fell off heavily, many debts were left undischarged and even gold hoards were dispersed. As elsewhere, emergency measures were taken. But matters soon righted themselves; for the price of cotton, stimulated by the demand for war purposes, gradually recovered until by the end of 1915 it again reached its pre-war level. The conversion of Egypt into a huge British military base for the Near Eastern theatre of war and the paradoxical political connection between the two countries, which gave Egypt the benefits of being on the winning side without the financial drain of actual belligerency, combined with the demand for Egyptian cotton, completed the economic rescue. Thus the maintenance of Egypt as a great base involved considerable expenditure on labour, military works, supplies and commodities of all kinds, which was defrayed by the British Government, or by the troops themselves, and materially contributed to the financial recovery of the country. It caused the British Government to provide and ensure the import of the coal necessary for the working of the railways, of the water supply, lighting and sewage systems of the towns, and of the thousands of irrigation pumps on which the cotton, food and fodder harvests largely depend. It necessitated the protection of the maritime routes to Egypt and brought large volumes of shipping to her ports, which greatly facilitated the export of cotton and the import of food, fuel and other necessaries. These favourable conditions continued throughout the war, and were accompanied by a steady increase in cotton prices and a great growth in the wealth of the country.

In the middle of 1919 the prices of Egyptian cotton soared in response to a feverish post-war demand and early in 1920 stood at more than 10 times the pre-war figure. They then fell as precipitously as they had risen, till in March 1921, they stood at little more than their pre-war level. The shock of the subsequent contraction of the national income fell most directly on the land-holding population, which, however, was in a good position to stand it, having been able to accumulate profits practically untouched by taxation during the previous years. On the other hand, the general fall in prices brought relief to the classes which had suffered from the continuous increase in the cost of living. For the growth of the national wealth since 1914 had been most unevenly distributed, and was accompanied by extreme contrasts of ease and want. The poorer classes in the towns, and large numbers of officials and others on small fixed salaries or purely money wages had suffered severely. The sudden fall in prices also caught the Government with large stocks of depreciated coal and cereals in its possession. For, as in other countries, the obligation to ensure essential supplies and partially to redress depreciation of the pay of public servants led the Government during the war to adopt special measures of food and fuel supply and in supplement of salaries. The liquidation of practically all these special liabilities and the reaction on public finance of the heavy fall in cotton prices fell into the working of the financial year 1920–21, which accordingly may most fittingly be held to terminate the war period for Egypt. She emerged from it, as the following shows, at a net cost to her public finances of just over £E.2,500,000; with moderately increased taxation and with greatly increased national wealth.

Statement, 1902, ... millions of £E. in the Pre-War, War and Post-War Periods

Date and period	Total revenue over each period	Total expenditure over each period	Reserve fund	Consol debt*
Jan. 1910 to March 1914	72·8	73·7	6·4 5·1	95·2 94·1
April 1914 to March 1921	184·0	187·6	5·1 1·5	94·1 93·0
April 1921 to March 1927	228·3	195·6	1·5 34·2	93·0 91·3†

*Excluding the Ottoman Tribute Loans.

†Of which the Govt. and the Caisse de la Dette held 12·3 in March 1927

In the above table revenue and expenditure are totalled for each period, and the reserve fund and consolidated debt for first and last years of each period are given. In reading the totals the unequal lengths of the periods must of course be considered.

Up to the latter part of 1926 there was no slackening in Egypt's march towards material prosperity. Political agitation notwithstanding, the public revenues moved steadily upwards; and once the post-war slump was surmounted, the period from 1921 was one of rapid growth in the foreign trade, great increase in bank deposits, a notable transfer of the public debt from European to Egyptian holders, a high level of Egyptian securities and a substantial discharge of agricultural debt. At the close of 1926 the situation changed somewhat, with the fall which took place in the world price of cotton. Though it probably did no more than bring the staple down to a normal post-war level, it emphasized the artificial rise that had occurred in the cost of living in Egypt and particularly the vicious inflation of agricultural rents. The purchasing power of the country was temporarily arrested, as shown by a sharp decline in imports; but there was much accumulated wealth from the preceding good years, and recovery was not unduly painful. A number of useful measures were taken by the Government to assist the cotton industry, and a policy of reducing and fixing the rents of the fellahin was discussed in parliament.

The chief elements in the national revenue and expenditure will appear from a brief analysis of the budget for 1928–29 (the financial year now runs from May to April):—

Revenue	£E
Customs	11,082,000
Railways	6,850,000
Direct Taxes	5,991,000
Cotton Tax	1,200,000
Other items	12,409,000
Total	37,532,000

Expenditure	£E
Railways	5,888,340
Public Debt	4,785,789
Irrigation	4,138,294
Police and Watchmen	2,813,231
Education	2,759,615
Pensions	2,220,300
Courts of Justice	1,520,509
Military	1,985,528
Other items	14,058,446
Total	40,170,052

Currency.—The monetary system dates from 1885, when through the efforts of Sir Edgar Vincent the currency was placed on a sound basis. Up to the World War, there was a gold monometallic standard, the nominal unit being the Egyptian pound, subdivided into 100 piastres and 1,000 milliemes. The British sovereign was legal tender at the rate of 975 milliemes, and constituted the real basis of the system. The notes of the National Bank of Egypt were current to a limited extent but were not legal tender. At the outbreak of the war, when the international circulation of gold stopped, it was found necessary to make these notes legal tender and to relieve the bank of the obligation to redeem them in gold. The public rapidly accustomed themselves to the use of notes and the disappearance of gold; the notes of the National Bank remain inconvertible for internal circulation; and the exchange has been remarkably steady. The Egyptian pound (£E)

is in practice equivalent to £1–0–6 in British money, and the piastre (P.T.) to 2½d. There are silver coins of 2, 5, 10 and 20 piastres; nickel coins of 1, 2, 5 and 10 milliemes and a bronze coin of ½ millieme, while the $\frac{1}{40}$ of a piastre, popularly called a para is still commonly used in reckoning among the poorer classes. The Dollar (Tallari) is reckoned at 20 piastres.

Agriculture and Land Tenure.—The chief industry of Egypt is agriculture. The proportions of the industry depend upon the area of land capable of cultivation. This again depends upon the fertilizing sediment brought down by the Nile and the measure in which lands beyond the natural reach of the flood water can be rendered productive by irrigation. By means of canals, "basins," dams and barrages, the Nile flood is now utilized to a greater extent than ever before (see Irrigation: *Egypt*). The result has been a great increase in the area of cultivated or cultivable land.

At the time of the French occupation of Egypt in 1798, it was found that the cultivable soil covered 4,429,400 acres, but the quantity actually under cultivation did not exceed 3,520,000 acres. Under improved conditions the area of cultivated land has risen to over 5½ million acres, and it is estimated that close on 8 million acres are cultivable.

Throughout Egypt the cultivable soil does not present any very great difference, being always the deposit of the river; it contains, however, more sand near the river than at a distance from it. Towards the Mediterranean its quality is injured by the salt with which the air is impregnated, and therefore it is not so favourable to vegetation. Of the cultivated land, some three-fourths is held, theoretically, in life tenancy. The state, as ultimate proprietor, imposes a tax which is the equivalent of rent. These lands are *Kharaji* lands, in distinction from the *Ushuri* or tithe-paying lands. The *Ushuri* lands were originally granted in fee, and are subject to a quit-rent. All tenants are under obligation to guard or repair the banks of the Nile in times of flood, or in any case of sudden emergency. Only to this extent does the *corvée* now prevail. Out of 1,153,759 proprietors of land in 1905, 1,005,705 owned less than 5 *feddans*. The number of proprietors owning over 50 *feddans* was 12,475. The acreage held by the first class was 1,264,084, that by the second class, 2,356,602. Over 1,600,000 *feddans* were held in holdings of from 5 to 50 *feddans*.

The kind of crops cultivated depends largely on whether the land is under perennial, flood or "basin" irrigation. Perennial irrigation is possible where there are canals which can be supplied with water all the year round from the Nile. This condition exists throughout the Delta and Middle Egypt, but only in parts of Upper Egypt; and under canal irrigation two and sometimes three crops can be harvested yearly. In tracts where perennial irrigation is impossible, the land is divided by rectangular dikes into "basins." Into these basins—which vary in area from 600 to 50,000 acres—water is led by shallow canals when the Nile is in flood. The silt-laden water is let in about the middle of August and the basins are begun to be emptied about the 1st of October. The land under basin irrigation grows only one crop a year; but the system is being steadily displaced by the extension of regular canals. This basin system is of immemorial use in Egypt, and it was not until Mohammed Ali (c 1820) determined on the cultivation of sugar and cotton that perennial irrigation was introduced on a large scale. High land near the banks of the Nile which cannot be reached by canals is irrigated by raising water from the Nile by steam-pumps, water-wheels (*sakias*) worked by buffaloes, or water-lifts (*shadufs*) worked by hand. The *fellah* divides his land into little square plots by ridges of earth, and from the small canal which serves his holding he lets the water into each plot as needed. There are three agricultural seasons: (1) summer (*sefi*), April to October; (2) flood (*Nili*), from mid-July to the end of November; and (3) winter (*shitwi*), from November to March. Cotton, sugar and rice are the chief summer crops; wheat, barley, flax and vegetables are chiefly winter crops; maize, millet and "flood" rice are *Nili* crops; millet and vegetables are also, but in a less degree, summer crops. The approximate areas under cultivation in the various seasons are, in summer, 2,050,000 acres; in flood, 2,300,000 acres; in winter, 4,000,000 acres. The double-cropped area is over 2,500,000 acres. Although on the large farms iron ploughs, and threshing and grain-cleaning machines, have been introduced, the small cultivator prefers the simple native plough made of wood. Corn is threshed by a *norag*, a machine resembling a chair, which moves on small iron wheels or thin circular plates fixed to axle-trees, and is drawn in a circle by oxen.

Egypt is third among the cotton-producing countries of the world, its production per acre being the greatest of any country and its staple of a distinctive quality. Approximately 200,000 acres, chiefly in Lower Egypt, are devoted to cotton growing. The seed is sown in February in Upper Egypt and the crop is picked in September and October; in the Southern part of the Delta, operations are a month later, and in the Lower Delta sowings on a large scale do not take place until April or pickings until November and December. The cotton crop increasing from 1,700,000 *cantars* in 1878 to 4,100,000 in 1890, had reached 7,965,000 *cantars* in 1926. The cotton exported was valued in 1926 at £E 34,371,000, and in the previous year, before the slump in prices, it had reached the figure of £E 51,660,000.

While cotton is grown chiefly in the Delta, the sugar plantations, which cover about 65,000 acres, are mainly in Upper Egypt. The canes are planted in March and are cut in the following January or February. Beetroot is also grown to a limited extent for the manufacture of sugar. The export of sugar varies greatly with the world demand and price; in 1920, for example, £E 1,145,000 was the value of the exports; in the following year £E 313,000. The Société Générale des Sucreries has sugar factories scattered all over Upper Egypt, and their establishment at Nag Hamadi is said to be the largest of its kind in the world.

A coarse, strong tobacco used to be extensively grown, but its cultivation was prohibited in 1891, and the tobacco used locally and for cigarette manufacture comes chiefly from Greece, Turkey, and Syria. The duty derived from its import accounts for more than half the total customs revenue. Flax was an important crop in dynastic times: but neither it nor hemp is now grown to any large extent.

Maize (dhurra) occupies an even larger area than cotton, and is chiefly grown in Lower Egypt. In Upper Egypt its place is taken by millets. Both grains form the staple food of the peasantry. The stalk of the maize is also a very useful article. It is used in the building of the houses of the fellahin, as fuel, and, when green, as food for cattle. Wheat and barley are important crops. The barley in general is not of good quality, but the desert or "Mariut" barley, grown by the Bedouins in the coast region west of Alexandria, is highly prized for the making of beer. Beans and lentils are extensively sown, and form an important article of export. Rice is largely grown in the northern part of the Delta, where the soil is very wet. Two kinds are cultivated: *Sultani*, a summer crop, and *Sabaini*, a flood crop. *Sabaini* is a favourite food of the fellahin, while *Sultani* rice is largely exported. In the absence of grass, the chief green food for cattle and horses is clover, grown largely in the basin lands of Upper Egypt. To a less extent vetches and lucerne are grown for the same purpose.

Vegetables grow readily, and their cultivation is an important part of the work of the fellahin. The onion is grown in great quantities along the Nile banks in Upper Egypt, largely for export. Among other vegetables commonly raised are tomatoes (the bulk of which are exported), potatoes (of poor quality), leeks, marrows, cucumbers, cauliflowers, lettuce, asparagus and spinach.

The common fruits are the date, orange, citron, fig, grape, apricot, peach and banana. Olives, melons, mulberries and strawberries are also grown, though not in very large numbers. The olive tree flourishes only in the Fayum and the oases. The Fayum also possesses extensive vineyards. The date is a valuable economic asset, being one of the chief foods of the people: and efforts are being made to improve the breeds and the fertility of the universal date-palm.

There are fields of roses in the Fayum, which supply the market with rose-water. Of plants used for dyeing, the principal are bastard, saffron, madder, woad and the indigo plant. The leaves of the henna plant are used to impart a bright red colour to the palms of the hands, the soles of the feet, and the nails of both hands and feet, of women and children, the hair of old ladies and the tails of

horses. Indigo is very extensively employed to dye the shirts of the poorer classes and is when very dark the colour of mourning, therefore women at funerals and generally after a death, smear themselves with it.

The Egyptians are not particularly a pastoral people, though the wealth of the Bedouin in the Eastern or Arabian desert consists in their camels, horses, sheep and goats. In the Nile valley the chief domestic animals are the camel, donkey, mule, ox, buffalo, sheep and goat. Horses are comparatively few, and are seldom seen outside the large towns, the camel and donkey being the principal beasts of burden. The cattle are short-horned, rather small and well formed. They are quiet in disposition, and much valued for agricultural labour by the people, who rarely slaughter them for meat. Buffaloes are largely employed for turning the *sakias*. Sheep (of which the greater number are black) and goats are abundant, and mutton is the ordinary butcher's meat. The wool is coarse and short. Poultry is plentiful and eggs form a considerable item in the exports. Pigeons are kept in every village and their flesh is a common article of food.

The chief fishing-ground is Lake Menzala, where some 4,000 persons are engaged in the industry, but fish are caught also in large quantities along the coast of the Delta. The salting and curing of the fish is done chiefly at Mataria, on Lake Menzala, and at Damietta. Dried and salted fish eggs, called *batarekh*, command a ready market. The Nile abounds in fish, but they are not table delicacies.

Canals.—The irrigation canals have from time immemorial been an outstanding feature in the agricultural life of Egypt, as they supplement the operations of the annual inundation of the Nile. Their role is becoming of increasing scope and importance, with the steady substitution of systematic perennial irrigation for the old wasteful system of basin irrigation. There are about 12,000 m. of irrigation canals, of which about 1,000 m., particularly in the Delta, are navigable for passengers and food. An essential concomitant of both the canals and the basins is an adequate system of drainage to prevent water-logging; and over 4,000 m. of main drainage courses are in operation.

The Delta canals derive their supply from four main channels. The Rayya Behera, known in its lower courses first as the Khatatba and afterwards as the Rosetta canal, follows the west bank of the Rosetta branch of the Nile and has numerous offshoots. The most important is the Mahmudia (50 m. long), which connects Alexandria with the Rosetta branch and supplies Alexandria with fresh water. The Rayya Menufia, or Menuf canal, connects the two branches of the Nile and supplies water to the large number of canals in the central part of the Delta. Following the right (eastern) bank of the Damietta branch is the Rayya Tewfiki, known below Benha as the Mansuria, and below Mansura as the Fareskur, canal. This canal has many branches. Farther east are other canals, of which the most remarkable occupy in part the beds of the Tanitic and Pelusiac branches. The superfluous water from all the Delta canals is drained off by *bahrs* (rivers) into the coast lakes.

The Ismailia or Fresh-water canal branches from the Nile at Cairo and follows, in the main, the course of the canal which anciently joined the Nile and the Red sea. It dates from Pharaonic times, having been begun by "Sesostris," continued by Necho II. and by Darius Hystaspes, and at length finished by Ptolemy Philadelphus. This canal, having fallen into disrepair, was restored in the 7th century A.D. by the Arabs who conquered Egypt, but appears not long afterwards to have again become unserviceable. The existing canal was dug in 1863 to supply fresh water to the towns on the Suez Canal.

In Upper Egypt the most important canals are the Ibrahimia and the Bahr Yusuf. They are both on the west side of the Nile. The Ibrahimia takes its water from the Nile at Assiut, and runs south to below Beni Suef. It now supplies the Bahr Yusuf, which runs parallel with and west of the Ibrahimia, until it diverges to supply the Fayum—a distance of some 350 m. It leaves the Ibrahimia at Derut near its original point of departure from the Nile. The Joseph whose name it bears was the famous Saladin: but he did little more than repair it, for it was probably executed under the Pharaohs. Besides supplying the canals of the Fayum with summer water, it fills many of the "basins" of Upper Egypt with water in flood time.

Weights and Measures.—The metrical system of weights and measures is in official but not in popular use. The most common Egyptian measures are the *pitr*, or space taken by the extension of the thumb and first finger; the *shibr* or span; and the cubit, varying from 22 to 26 inches. The land unit is the *feddan*, = nearly 1·04 acres, and divided into 24 *kirats*. The chief measure of weight is the *cantar* (of 100 *rotls* or 36 *okes*), and usually = 99·05 lb.; but a *cantar* of ginned cotton = 100 lb. and of unginned cotton = 315 lb. For delicate weights the *dirhem* (of 16 *kirats*) = 48 grams troy. The *Ardeb* = nearly 43½ gallons or 5½ bushels; and there are no specific liquid measures, as fluids are generally bought and sold by weight.

Time.—The time kept is that of 30 E., and is thus 2 hours ahead of Greenwich. In A.D. 1928, the Muslim year 1347 began on June 19, and the Coptic year 1645 on Sept. 11.

Manufactures and Industries.—Although essentially an agricultural country, Egypt is steadily developing its industrial capacity; and an integral feature of the nationalist movement is the extension of the manufacturing activities of the country and the larger conversion within the country itself of its raw materials into their finished products. The primary Egyptian industry, cotton, is still largely in the export stage; there are about 150 ginning factories scattered about the country, and some 200 presses; but the spinning of yarn and the extraction of oil from the seed are both yet on a very small scale. One consequence of the recent slump in prices has been a scheme for the erection of a large weaving factory near the Barrage. Sugar stands on a very different footing, the manufacture of refined sugar and molasses being efficiently exploited by a powerful French company, owning a number of highly organized refineries in Upper Egypt; their output of fine sugar has in some years exceeded 100,000 tons. Several towns in the Delta possess rice mills; and flour mills are found in every part of the country, the maize and other grains being ground for home consumption. Cement (about 50,000 tons a year) is manufactured by a Belgian company at Massaarah. Soap-making and leather-tanning are carried on, and there are breweries at Alexandria and Cairo. The manufacture of imported tobacco into cigarettes, carried on largely at Alexandria and Cairo, is an industry of considerable importance, though somewhat affected by the growing preference in Europe, since the war, for cheaper brands. Indigenous industries include the weaving of silk, woollen, linen and cotton goods, the hand-woven silk shawls and draperies being often rich and elegant. The silk looms are chiefly at Mehallet el-Kubra, Cairo and Damietta. The Egyptians are noted for the making of pottery of the commoner kinds especially water-jars. There is at Cairo and in other towns a considerable industry in ornamental wood and metal work, inlaying with ivory and pearl, brass trays, copper vessels, gold and silver ornaments, etc. At Cairo and in the Fayum, attar of roses and other perfumes are manufactured. Boat-building is an important trade.

Mines. (*See* also under *Minerals.*)—Of recent years a systematic effort has been made by the Government to facilitate mineral discovery and development. The geological survey of the country, started in 1896, has been steadily pursued ever since; and ten years later, standard mining licences and leases were substituted for concessions covering large areas and shutting out general prospecting. In 1926 the mining industry as a whole gave employment to an average of 3,224 Egyptians and 135 Europeans; while continued interest was shown in prospecting. Apart from the carbonate of soda obtained from the natron lakes, petroleum and manganese ore are the chief products of the industry, and the output of phosphate, due largely to an Italian company at Kosseir, rose to 232,000 metric tons in 1926. There is a substantial quarrying business in stone and materials for concrete, plaster and brick-making; all this of course is confined to the desert area.

Trade Routes and Communications.—Its geographical position gives Egypt command of one of the most important trade

[illegible] ...ter routes across the highway from Europe to the East. This has been the case from time immemorial, and the creation, in 1869, of direct maritime communication between the Mediterranean and the Red sea, by the completion of the Suez canal, ensured for the Egyptian route the supremacy in seaborne traffic to Asia which the discovery of the passage to India by way of the Cape of Good Hope had menaced for three and a half centuries. The Suez canal (q.v.), however, has economic and political reactions on Egypt which far transcend its importance as a route for local trade. Still the value of a harbour like Port Said, which is visited by the many steamship lines which use the canal, is inestimable. Besides the shipping which passes through the canal other steamers run direct from European ports to Alexandria. There is also a direct mail service between Suez and Port Sudan.

The chief means of internal communication are, in the Delta the railways, in Upper Egypt the railway and the river. The railways are of two kinds: (a) those state-owned and state-worked, (b) light railways owned and worked by private companies. Railway construction dates from 1852, when the line from Alexandria to Cairo was begun, by order of Abbas I. The state railways have a gauge of 4 ft. 8½ in. The main system is extremely simple. Trunk lines from Alexandria (via Damanhur and Tanta) and from Port Said (via Ismailia) traverse the Delta and join at Cairo. From Cairo the railway is continued south up the valley of the Nile and close to the river. At first it follows the west bank, crossing the stream at Nag Hamadi, 554 m. from Cairo, by an iron bridge 457 yd long. Thence it continues on the east bank to Shellal, 3 m. above Aswan and 685 m. from Alexandria. This main line service is supplemented by a steamer service on the Nile from Shellal to Wadi Halfa, on the northern frontier of the Anglo-Egyptian Sudan, whence there is direct railway communication with Khartum and the Red sea (*see* SUDAN).

Branch lines connect Cairo and Alexandria with Suez and with almost every town in the Delta. Before the Suez canal was opened passengers and goods were taken to Suez from Cairo by a railway 84 m. long which ran across the desert. This line, now disused, had itself superseded the "overland route" organized by Lieutenant Thomas Waghorn, R.N., *c.* 1830, for the conveyance of passengers and mails to India. In Upper Egypt a line, 40 m. long, runs west from Wasta, a station 56 m. S. of Cairo, to Abuksa in the Fayum. Another railway (narrow gauge) goes from Kharga Junction, a station on the main line 24 m. S. of Girga, to the oasis of Kharga.

In the Delta the light railways supplement the ordinary lines and connect the villages with the towns and seaports. There is also a network of private lines in the Fayum, all these being on the 75 c.m. gauge. In 1880 944 m. of state lines were open; in 1900 the figure was 1,393, and it is now close on 2,500 m. For several years before 1904 the administration of the railways was carried on by an international or mixed board for the security of foreign creditors. In the year named the railways came directly under the control of the Egyptian government, and development has been steady though not rapid. The light railways owned by private companies are over 800 m. in length.

Westward from Alexandria a railway, begun in 1904 by the khedive, Abbas II., runs parallel with the coast, and is intended to be continued to Tripoli. The line forms the eastern end of the great railway system which will eventually extend from Tangier to Alexandria. During the World War railway connection with Palestine was effected from Kantara on the Canal across Northern Sinai, and has since been maintained.

The Nile is navigable throughout its course in Egypt, and is largely used as a means of cheap transit of heavy goods. Lock and bridge tolls were abolished in 1899 and 1901, respectively. Above Cairo the Nile is the favourite tourist route, while between Shellal and the Sudan frontier it is the only means of communication. Among the craft using the river the *dahabiya* is a characteristic native sailing vessel, somewhat resembling a house-boat. From the Nile, caravan routes lead westward to the various oases and eastward to the Red sea, the shortest (120 m.) and most used of the eastern routes being that from Kena to Kosseir.

Roads suitable for wheeled vehic... but the majority of the tracks ar... still the chief vehicle of trade, e... methods, however, are asserting th... car is increasing; and in 1927 ... registered was 9,712 cars, 5,195 ... and 1,087 omnibuses. The Imp... a weekly service for mails and ... Basra, via Gaza and Baghdad.

The Egyptian postal system is ... and in striking contrast with its ... were but nineteen post-offices in ... of business transacted in Europea... the Egyptian service, Egypt being ... It was the first foreign country to ... Great Britain, and there are now ... postal stations. Post-office saving ... headway.

All the important towns are c... graphs being state-owned and wo... tion. Egypt is also connected by ... outside world. One land-line con... through Syria and Asia Minor t... connects at Wadi Halfa with the ... telegraphic communication via ... Uganda and Mombasa. The Ea... concessions, have telegraph lines ... via Cairo to Suez, and from Port ... cables to Europe and the East. ... Alexandria to Malta, Gibraltar ... to Crete and Brindisi; from Sue... Australia. Wireless stations at ... to the public, and an agreement w... Co in 1926 for establishing con... Abu Zabal near Cairo.

Commerce.—The trade of Eg... since the British occupation in 18... of its external trade was £19 millio... and in the interval it had freque... eral movement in recent years is ...

Annual Returns of Value of Impor...

Year	Imports	Exports
1911 .	27·3	28·9
1912 .	25·9	34·6
1913 .	27·9	31·7
1914 .	21·7	24·1
1915 .	19·4	27·0
1916 .	31·1	37·5
1917 .	33·2	41·1
1918 .	51·2	45·4

The wealth of Egypt lying in t... all the exports are agricultural ... mostly manufactured goods, min... exports in order of importance are ... cigarettes, onions, eggs, phospha... gum is not of native produce, b... Of less importance are the export... other grains, wool, quails, lentil... transit. The principal articles ir... other textiles, coal, iron and ste... flour, automobiles, alcoholic liquo... live animals. There is an *ad valor*... of about 1% on exports. Alcohol, ... of luxury pay heavier duties; and ... tariff on tobacco. The tobacco is ... Syria and Greece, is made into ... form exported to a value which h... year, but is now down to about o...

In comparison with cotton a... account. The cotton exported, of ... one-half is worth over four-fifths ...

broad. Next to cotton sugar is the most important article exported. A large proportion of the sugar manufactured is, however, consumed in the country and does not figure in the trade returns. Of the imports the largest single item is cotton goods, three-fourths of which are sent from England. Woollen goods come chiefly from England and Germany, silk goods from France. Iron and steel goods, machinery, locomotives, etc., come chiefly from England, Belgium, the U.S.A. and Germany, coal from England, live stock from Turkey and the Red sea ports, coffee from Brazil, timber from Russia, Turkey and Sweden.

In 1926 the largest importing nation was Great Britain, though its share in the total imports was down to 22% against a considerably higher ratio in previous years; the rest of the British empire provided another 11%. France had a fairly steady share in the import business at 11%; and Italy had fallen to 9%. Next to these countries came Germany with 7%, the U.S.A. with 5%, and Belgium with 4%; while Turkey, which once ranked second in the list, had less than 3%. In her export trade, Egypt's best customer continues to be Great Britain, though its part in the total exports had fallen from a more predominant figure to 45% in 1926. Next came the U.S.A. with 13% and France with 12% of the trade; Italy had less than 6% and Germany less than 5%, Japan and Switzerland following with still smaller ratios. The normal distribution of the external commerce was, it should be noted, to some extent dislocated in 1926 by the coal stoppage in England and the appreciation of the lira in Italy.

Cotton.—Egypt's disposable wealth for purposes of foreign trade is predominantly represented by the value of her cotton exports, which has been as high as £80 millions in 1920, and stood at £55 millions before the great fall in prices of 1926. Although these exports satisfy only about 4% of the world's consumption, the length and strength of the best Egyptian fibre enables it to command a marked premium in price over practically all other cottons. It is this virtual monopoly of the finest cotton and the great rise in the price of cotton generally which set the scale of Egypt's leap into prosperity. No reliable analysis can be given of the amount of the total payment annually remitted by other countries to Egypt for her cotton, which represents this premium: but its importance and the seriousness of the loss if Egyptian cotton did not possess the advantage mentioned can be gauged by comparing the average price, over a series of years of Egyptian standard cotton with what is known as American middling. At the beginning of this century, the advantage in favour of the Egyptian product was 35%. It steadily rose, until during the war period it reached the striking figure of 82%: and since the war it has averaged over 50%. While these premiums are simply indices of the relative demand for Egyptian and American standard cottons in the market of the most important outside purchaser, the maintenance of the higher quality of which they are the reflection is of outstanding importance to Egypt, as otherwise her cotton would become a satellite of American and follow its price levels. While Egypt's primary economic interest is thus the maintenance of the present pre-eminence in the quality of her cotton, the danger that this advantage may be discounted by a falling off in quantity also calls for serious attention. The general statistics of the crop have indicated for a long time past a decline in the yield per feddan; it was 5·2 cantars at the beginning of this century; it is now under 4 cantars per feddan. Fears have been expressed that the cotton lands are suffering from want of an adequate rotation of crops; or from over-saturation: or from the loss of fertilizing silt which the old inundation system provided but which is lacking in canal water. Even, however, if we assume the dependability and equal weight of the statistics throughout, there have been important disturbing factors at work, which make it advisable to accept with caution as yet the deduction that the culture of the cotton plant is, for one or other reason, generally less successful than it used to be. Among such factors may be mentioned the extension of cotton culture into less fertile districts and the cultivation of varieties, such as Sakellarides, which appear to combine better quality lint with lower yield. (*See* COTTON.) A congress of the International Federation of Master Cotton Spinners' and Manufacturers' Associations was held in Egypt early in 1927, and urged the Government to make every effort to improve the quality and increase the yield of Egyptian cotton, and to maintain and improve the drainage system.

Shipping.—More than 90% of the external trade used to pass through the port of Alexandria; but the ratio has been reduced by the canal ports to about two-thirds. Over 4,000 ships enter and clear harbour at Alexandria every year. The total tonnage entering the port was 4½ million tons in 1925. Of the total volume of cargo landed and shipped at all the Egyptian ports in 1926, about 45% is carried by British vessels, 14% by Italian, 11% by Greek and 6% by German. Of the total number of passengers landed and embarked, 44% travelled in British, 25% in Italian and 15% in French vessels.

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(*b*) Administration: Sir John Bowring's *Report on Egypt . . .* to Lord Palmerston (1840) shows the system obtaining at that period. For the study of the state of Egypt at the time of the British occupation, 1882, and the development of the country since, the most valuable documents are:

I. *Official.*—The *Reports on the Finances, Administration and Condition of Egypt*, issued yearly since 1892 (the reports 1888–91 were exclusively financial). Annual returns are published in Cairo in English or French by the various ministries, and a useful report on the *Economic and Financial Situation of Egypt* is published annually by the British department of Overseas Trade on the trade of Egypt and of Alexandria and of the tonnage and shipping of the Suez Canal are also issued yearly.

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(*c*) Law: H. Lamba, *De l'évolution de la condition juridique des Européens en Égypte* (1896); J. H. Scott, *The Law affecting Foreigners in Egypt . . .* (1907); *The Egyptian Codes* (1892).

(*d*) Irrigation, agriculture, geology, etc.: *Despatch from Sir Evelyn Baring Enclosing Report on the Condition of the Agricultural Population in Egypt* (1888). The reports (*Egypt*, No. 2, 1901, and *Egypt*, No. 2, 1904), by Sir William Garstin on irrigation projects on the Upper Nile are very valuable records—notably the 1904 report. W. Willcocks, *Egyptian Irrigation* (2nd ed., 1899). Annual meteorological reports are issued by the Public Works Department, Cairo. The same department issues special irrigation reports. *See* for geology Carl von Zittel, *Beiträge zur Geologie und Paläontologie der libyschen Wüste* (Cassel, 1883); *Reports of the Geological Survey of Egypt* (Cairo, 1900, *et seq.*).

HISTORY

I. EARLIEST TIMES TO MUSLIM CONQUEST

The Prehistoric Age.—Tradition, mythology and later customs make it possible to recover a scrap of the political history of prehistoric Egypt. Menes, the founder of the 1st Dynasty, united the two kingdoms of Upper and Lower Egypt. In the prehistoric period, therefore, these two realms were separate. The capital of Upper Egypt was Nekheb, now represented by the ruins of El Kab, with the royal residence across the river at Nekhen (Hieraconpolis); that of Lower Egypt was at Buto in the marshes, with the royal residence in the quarter called Pe. Nekhêbi, goddess of El Kab, represented the Upper or Southern Kingdom, which was also under the tutelage of the god Seth, the goddess Buto and the god Horus similarly presiding over the Lower Kingdom. The royal god in the palace of each was a hawk or Horus. The spirits of the deceased kings were honoured respectively as the jackal-headed spirits of Nekhen and the hawk-headed spirits of Pe. As we hear also of the "Spirits of On" it is probable that Heliopolis was at one time capital of a kingdom. In

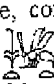
after days the prehistoric kings were known as "Worshippers of Horus" and in Manetho's list they are the νέκυες, "Dead" and ἥρωες, Heroes," being looked upon as intermediate between the line dynasties and those of human kings.

It is doubtful whether we possess any writing of the prehistoric age. A few names of the kings of Upper and of Lower Egypt are preserved in the first line of the Palermo stone, but no annals are attached to them.

Archaic Period.—Names of a number of kings attributable to the 1st dynasty are known from tombs at Abydos. Unfortunately, with few exceptions they are "Horus titles" in place of personal names by which they were recorded in lists of Abydos and Manetho. Perhaps the earliest king of the dynasty is one whose name has been provisionally read Nar-mer; of him there exists a magnificent carved and inscribed slate palette found at Hieraconpolis with figures of the king and his vizier, war standards and prisoners. Another very early king is Aha; his name is found in two tombs, one at Nagâdc, north of Thebes and nearly opposite the road to the Red Sea, the other at Abydos. Manetho makes the 1st dynasty "Thinite"; This being the capital of the "nome" in which Abydos lay, Menes must represent either Nar-mer or Aha or both. Upper Egypt always had precedence over Lower Egypt and it seems clear that Menes came from the former and conquered the latter. According to tradition he founded Memphis, which lay on the frontier of his conquest; probably he resided there as well as at Abydos; at any rate relics of one of the later kings of the 1st dynasty have already been recognized in its vast necropolis. Of the eight kings of the 1st dynasty, three—the fifth, sixth and seventh in the Ramesside list of Abydos—are positively identified by their names on objects from the royal tombs at Abydos and others are scarcely less certain. Two of the kings have also left tablets at the copper and turquoise mines of Wadi Maghâra in Sinai. The royal tombs are built of brick, but one of them, that of Usaphais, had its floor of granite from Elephantine. They must have been filled with magnificent furniture and provisions of every kind, including even annual record-tablets of the reigns, carved in ivory and ebony. The annals of the Palermo stone commenced with the 1st dynasty.

The 2nd dynasty of Manetho appears to have been separated from the 1st even on the Palermo stone; it also was Thinite, and the tombs of several of its nine (?) kings were found at Abydos. The 3rd dynasty is given as Memphite by Manetho. Two of the kings built huge mastaba-tombs at Bêt Khallaf near Abydos, but the architect and learned scribe Imhôtp designed for one of these two kings, named Zoser, a second and mightier monument at Memphis, the great step-pyramid of Sakkara with all its wonderful appurtenances. Zoser and Imhôtp built also at Heliopolis. (In Ptolemaic times Imhôtp received the honour of deification.) Monuments and written records are henceforth more numerous and important, and the fragments of the Palermo annals show a very full scale of record for the reign of Snefru at the end of this dynasty. The events in the three years that are preserved include a successful raid upon the Nubians and the construction of ships and gates of cedar-wood which must have been brought from the forests of the Lebanon. Snefru also set up a tablet at Wadi Maghâra in Sinai. He built two pyramids, one of them at Mêdûm in steps, the other, probably in the perfected form, at Dahshûr, both lying between Memphis and the Fayûm.

The Pyramid Period.—Pyramids did not cease to be built in Egypt till the New Kingdom; but from the end of the 3rd to the 6th dynasty is pre-eminently the time when the royal pyramid in stone was the chief monument left by each successive king. Zoser and Snefru have been already noticed. The personal name enclosed in a cartouche  is henceforth the commonest title of the king. We now reach the 4th dynasty containing the famous Herodotean names of Cheops (*q.v.*), Chephren (Khafrê) and Mycerinus (Menkeurê), builders respectively of the Great, the Second and the Third Pyramids of Giza. In the best art of this time there was a grandeur which was never again attained. Perhaps the noblest example of Egyptian sculpture in the round is a [illegible] statue of [illegible] one of several found by [illegible] in the so-called Temple of the Sphinx. This [illegible] to be a monumental gate at the lower end of the great causeway leading to the plateau on which the pyramids were built. A king Dedefrê, between Cheops and Chephren, built a pyramid at Abu-Roâsh. Shepseskaf is one of the last in the dynasty. Tablets of most of these kings have been found at the mines of Wadi Maghâra. In the neighbourhood of the pyramids there are numerous mastabas of the court officials with fine sculpture in the chapels, and a few decorated tombs from the end of this centralized dynasty of absolute monarchs are known in Upper Egypt. A tablet which describes Cheops as the builder of various shrines about the Great Sphinx has been shown to be a priestly forgery, but the Sphinx itself may have been carved out of the rock under the splendid rule of the 4th dynasty.

The 5th dynasty is said to be of Elephantine, but this must be a mistake. Its kings worshipped Rē, the sun, rather than Horus as their ancestor, and the title  "son of the Sun" began to be written by them before the cartouche containing the personal name, while another "solar" cartouche, containing a name compounded with Rē, followed the title  "king of Upper and Lower Egypt." Sahurē and the other kings of the dynasty built magnificent temples with obelisks dedicated to Rē, one of which, that of Neuserrē at Abusîr has been thoroughly explored. The marvellous tales of the Westcar Papyrus, dating from the Middle Kingdom, narrate how three of the kings were born of a priestess of Rē. The pyramids of several of the kings are known. The early ones are at Abusîr, and the best preserved of the pyramid temples, that of Sahurē, excavated by the German Orient-Gesellschaft in its architecture and sculptured scenes, has revealed an astonishingly complete development of art and architecture as well as warlike enterprise by sea and land at this remote period; the latest pyramid belonging to the 5th dynasty, that of Unas at Sakkāra is inscribed with long ritual and magical texts. Exquisitely sculptured tombs of this time are very numerous at Memphis and are found throughout Upper Egypt. Of work in the traditional temples of the country no trace remains, probably because, being in limestone, it has all perished. The annals of the Palermo stone were engraved and added to during this dynasty; the chief events recorded for the time are gifts and endowments for the temples. Evidently priestly influence was strong at the court. Expeditions to Sinai and Puoni (Punt) are commemorated on tablets.

The 6th dynasty if not more vigorous was more articulate; inscribed tombs are spread throughout the country. The most active of its kings was the third, named Pepi or Phiops, from whose pyramid at Sakkāra the capital, hitherto known as "White Walls" derived its later name of Memphis (MN–NFR, Mempi); a tombstone from Abydos celebrates the activity of a certain Una during the reigns of Pepi and his successor in organizing expeditions to the Sinai peninsula and south Palestine, and in transporting granite from Elephantine and other quarries. Herkhuf, prince of Elephantine and an enterprising leader of caravans to the south countries both in Nubia and the Libyan oases, flourished under Merenrē and Pepi II. called Neferkerē. On one occasion he brought home a dwarf dancer from the Sudan, described as being like one brought from Puoni in the time of the 5th dynasty king Asesa; this drew from the youthful Pepi II. an enthusiastic letter which was engraved in full upon the façade of Herkhuf's tomb. The reign of the last-named king, begun early, lasted over 90 years, a fact so long remembered that even Manetho attributes to him 94 years. its length probably caused the ruin of the dynasty. The local princelings and monarchs had been growing in culture, wealth and power, and after Pepi II. an ominous gap in the monuments, pointing to civil war, marks the end of the Old Kingdom.

The Early Intermediate Period.—The 7th and 8th dynasties are said to have been Memphite, but of them scarcely any record survives beyond some names of kings in the lists. Literary texts record a complete upset of social order and the intrusion of an invading race. The duration of this dark and miserable period is unkn[illegible] The long Memphite rule was broken by the 9th and 10th [illegible] of H[illegible]s Magna (Hnēs) in Middle Egypt. They may have spread their rule by conquest over Upper Egypt

and then overthrown the Memphite dynasty. Kheti or Achthoes was apparently a favourite name with the kings, but they are very obscure. It would seem that after they in turn were overthrown their monuments at Heracleopolis were systematically destroyed. The chief relics of the period are certain inscribed tombs at Assiût; it appears that one of the kings, whose praenomen was Mikerê, supported by a fleet and army from Upper Egypt, and especially by the prince of Assiût, was restored to his paternal city of Heracleopolis, from which he had been driven out; his pyramid, however, was built in the old royal necropolis at Memphis.

The Middle Kingdom.—The princes of Thebes asserted their independence and founded the 11th dynasty, which pushed its frontiers northwards until finally it occupied the whole country. Its kings were named Menthotp (from Mont, one of the gods of Thebes) and Antef, and were buried at Thebes. Nibhôtp Menthotp I probably established his rule over all Egypt. The funerary temple of Nebheprê Menthotp III., the last but one of these kings, has been excavated by the Egypt Exploration Fund at Deir el Bahri, and must have been a magnificent monument. His successor, Sankhkerê Menthotp IV. is known to have sent an expedition by the Red sea to Puoni

Monuments of the Theban 12th dynasty are abundant and often of splendid design and workmanship, whereas previously there had been little produced since the 6th dynasty that was not half barbarous. Although not much of the history of the 12th dynasty is ascertained, the Turin papyrus and many dated inscriptions fix the succession and length of reign of the eight kings very accurately The troubled times that the kingdom had passed through taught the long-lived monarchs the precaution of associating a competent successor on the throne. The "nomarchs" and the other feudal chiefs were inclined to strengthen themselves at the expense of their neighbours; a firm hand was required to hold them in check and distribute the honours as they were earned by faithful service. The tombs of the most favoured and wealthy princes are magnificent, particularly those of certain families in Middle Egypt at Beni Hasan, El Bersha, Assiût and Deir Rîfa, and it is probable that each had a court and organization within his districts or "nome" like that of the royal palace in miniature. Eventually, in the reigns of Senwosri III. and Amenemhê III. the succession of strong kings appears to have centralized all authority very completely. The names in the dynasty are Amenemhê (Ammenemes) and Senwosri (formerly read Usertsen or Senusert). The latter seems to be the origin of Sesostris (*q.v.*) of the legends. Amenemhê I., the first king, whose connection with the previous dynasty is not known, reigned for 30 years, ten of them being in partnership with his son Senwosri I. He had to fight for his throne and then reorganize the country, removing his capital or residence from Thebes to a central situation near Lisht, about 25m. south of Memphis. His monuments are widespread in Egypt, the quarries and mines in the desert as far as Sinai bear witness to his great activity, and we know of an expedition which he made against the Nubians. The "Instructions of Amenemhê to his son Senwosri," whether really his own or a later composition, refer to these things, to his care for his subjects, and to the ingratitude with which he was rewarded, an attempt on his life having been made by the trusted servants in his own palace. The story of Sinûhi is the true or realistic history of a soldier, who having overheard the secret intelligence of Amenemhê's death, fled in fear to Palestine or Syria and there became rich in the favour of the prince of the land; growing old, however, he successfully sued for pardon from Senwosri and permission to return and die in Egypt.

Senwosri I. was already the executive partner in the time of the co regency, warring with the Libyans and probably in the Sudan. After Amenemhê's death he fully upheld the greatness of the dynasty in his long reign of 45 years. The obelisk of Heliopolis is amongst his best-known monuments, and the damming of the Lake of Moeris (*q.v.*) must have been in progress in his reign. He built a temple far up the Nile at Wadi Halfa and there set up a stela commemorating his victories over the tribes of Nubia. The fine tombs of Ameni at Beni Hasan and of Hepzefa at Assiût belong to his reign. The pyramids of both father and son are at Lisht

Amenemhê II. was buried at Dahshûr; he was followed by Senwosri II., whose pyramid is at Illahûn at the mouth of the Fayûm In his reign were executed the fine paintings in the tomb of Khnemhotp at Beni Hasan, which include a remarkable scene of Semitic Bedouins bringing eye-paint to Egypt from the eastern deserts. In Manetho he is identified with Sesostris (*see* above), but Senwosri I and still more Senwosri III. have a better claim to this distinction. The latter warred in Palestine and in Nubia, and marked the south frontier of his kingdom by a statue and stelae at Semna beyond the Second Cataract. Near his pyramid was discovered the splendid jewellery of some princesses of his family. The tomb of Thethotp at El Bersha, celebrated for the scene of the transport of a colossus amongst its paintings was finished in this reign

Amenemhê III. completed the work of Lake Moeris and began a series of observations of the height of the inundation at Semna which was continued by his successors. In his reign of 46 years he built a pyramid at Dahshûr, and at Hawara near the Lake of Moeris another pyramid, together with the Labyrinth which seems to have been an enormous funerary temple attached to the pyramid. His name was remembered in the Fayûm during the Graeco-Roman period and his effigy worshipped there as Pera-marres; *i.e.*, Pharaoh Marres (Marres being his praenomen graecized). Amenemhê IV.'s reign was short, and the dynasty ended with a queen Sebeknefru (Scemiophris), whose name is found in the scanty remains of the Labyrinth. The 12th dynasty numbered eight rulers and lasted for 213 years. Great as it was, it created no empire outside the Nile valley, and the Labyrinth, its most imposing monument, which according to the testimony of the ancients rivalled the pyramids, is now represented only by a vast bed of quarrymen's chips.

The Later Intermediate Period.—The history of this is very obscure. Manetho gives us the 13th (Diospolite) dynasty, the 14th (Xoite from Xois in Lower Egypt), the 15th and 16th (Hyksos) and the 17th (Diospolite) but his names are lost except for some Hyksos kings. The Abydos tablet ignores all between the 12th and 18th dynasties. The Turin papyrus preserves many names on its shattered fragments, and the monuments are for ever adding to the list, but it is difficult to assign them accurately to their places. The Hyksos names can in some cases be recognized by their foreign aspect, the peculiar style of the scarabs on which they are engraved or by resemblances to those recorded in Manetho The kings of the 17th dynasty too are generally recognizable by the form of their name and other circumstances. Manetho indicates marvellous crowding for the 12th and 14th dynasties, but it seems better to suggest a total duration of 300 or 400 years for the whole period than to adopt Meyer's estimate of about 210 years.

Amongst the kings of the 13th dynasty (including perhaps the 14th) not a few are represented by granite statues of colossal size and fine workmanship, especially at Thebes and Tanis, some by architectural fragments, some by graffiti on the rocks about the First Cataract. Some few certainly reigned over all Egypt Sebkhotp is a favourite name, no doubt to be connected with the god of the Fayûm. Several of the Theban kings named Antef must be placed here rather than in the 11th dynasty. A decree of one of them degrading a nomarch who had sided with his enemies was found at Coptos engraved on a doorway of Senwosri I

In its divided state Egypt would fall an easy prey to the foreigner. Manetho says that the Hyksos (*q.v.*) gained Egypt without a blow. Their domination must have lasted a considerable time the Rhind mathematical papyrus having been copied in the 33rd year of a king Apophis. The monuments and scarabs of the Hyksos kings are found throughout Upper and Lower Egypt and even in Nubia; those of Khian somehow spread as far as Crete and Baghdad. The Hyksos, in whom Josephus recognized the children of Israel, worshipped their own Syrian deity, identifying him with the Egyptian god Seth, and endeavoured to establish his cult throughout Egypt, to the detriment of the native gods. It is to be hoped that definite light may one day be forthcoming on the whole of this critical episode which had such a profound effect on the character and history of the Egyptian people. The spirited overthrow of the Hyksos ushered in the glories in arms and arts which marked the New Empire The 17th dynasty in which the

[illegible] in the great find of royal mummies at Deir el Bahri shows the head frightfully hacked and split, perhaps in a battle with the Hyksos.

The New Empire.—The epithet "new" is generally attached to this period, and "empire" instead of "kingdom" marks its wide conquests and organized rule abroad. The glorious 18th dynasty seems to have been closely related to the 17th. Its first task was to crush the Hyksos power in the north-east of the Delta, this was fully accomplished by its founder Ahmosi (or Amasis) capturing their great stronghold of Avaris. Amasis next attacked them in south-west Palestine, where he captured Sharuhen after a siege of three years. He fought also in Nubia, besides overcoming factious opposition in his own land. The principal source for the history of this time is the biographical inscriptions at El Kab of a namesake of the king, Ahmosi son of Abana, a sailor and warrior whose exploits extend to the reign of Tuthmosis I. Amenophis I (Amenhotp) succeeding Amasis, fought in Libya and extinguished finally an Ethiopian kingdom which, centred at Kerma near the Third Cataract, had flourished since the end of the 12th dynasty. Tuthmosis I. (*c.* 1540 B.C.) was perhaps of another family, but obtained his title to the throne through his wife Ahmosi. After some 30 years of settled rule uninterrupted by revolt Egypt was now strong enough and rich enough to indulge to the full its new taste for war and lust of conquest. It had become essentially a military state. The whole of the administration was in the hands of the king with his vizier and other court officials; no trace of the feudalism of the Middle Kingdom survived. Tuthmosis thoroughly subdued Cush, which had already been placed under the government of a viceroy, whose dominion extended from Napata just below the Fourth Cataract on the south to El Kab in the north, so that it included the first three "nomes" of Upper Egypt, which agriculturally were not greatly superior to Nubia. Turning next to Syria, Tuthmosis carried his arms as far as the Euphrates. He made the first of those great additions to the temple of the Theban Ammon at Karnak by which the pharaohs of the empire rendered it by far the greatest of the existing temples in the world; the temple of Deir el Bahri was also designed by him. Towards the end of his reign, his elder sons being dead, Tuthmosis associated Hatshepsut, his daughter by Ahmosi, with himself upon the throne. He was the first of a long line of kings to be buried in the Valley of the Tombs of the Kings at Thebes. A son, Tuthmosis II., succeeded as the husband of his half-sister Hatshepsut, but reigned only two or three years, during which he warred in Nubia and placed Tuthmosis III., his son by a concubine Esi, upon the throne beside him (*c.* 1500 B.C.). After her husband's death the ambitious Hatshepsut assumed the full regal power; upon her monuments she wears the masculine garb and aspect of a king, though the feminine gender is retained for her in the inscriptions. On some monuments of this period her name appears alone, on others in conjunction with that of Tuthmosis III., while the latter again may appear without the queen's; but this extraordinary woman must have had a great influence over her stepson and was the acknowledged ruler of Egypt. Hatshepsut cultivated the arts of peace. She restored the worship in those temples of Upper and Lower Egypt which had not yet recovered from the religious oppression and neglect of the Hyksos. She completed and decorated the temple of Deir el Bahri, embellishing its walls with scenes calculated to establish her claims, representing her divine origin and upbringing under the protection of Ammon, and her association on the throne by her human father. The famous sculptures of the great expedition by water to Puoni, the land of incense on the Somali coast, are also here, with many others. At Karnak, Hatshepsut laboured chiefly to complete the works projected in the reigns of Tuthmosis I. and II., and set up two obelisks in front of the entrance as it then was. One of these, still standing, is the most brilliant ornament of that wonderful temple. A date of the 22nd year of her reign has been found at Sinai, no doubt counted from the beginning of the co-regency with Tuthmosis I. Not much later, in his 22nd year, Tuthmosis III. is reigning alone in full vigour. While she lived, the personality of the queen secured the devotion of her servants and held all ambitions in check. Not long after her death there was a [illegible] reaction. Prejudice against the rule of a woman, particularly one who had made her name and figure so conspicuous, was probably the cause of this outbreak, and perhaps sought justification in the fact that, however complete was her right, she had in some degree usurped a place to which her stepson (who was also her nephew) had been appointed. Her cartouches began to be defaced or her monuments hidden by other buildings, and the same rage pursued some of her most faithful servants in their tombs. But the beauty of the work seems to have restrained the hand of the destroyer. Then came the religious fanaticism of Ikhnaton, mutilating all figures of Ammon and all inscriptions containing his name; this made havoc of the exquisite monuments of Hatshepsut; and the restorers of the 19th dynasty, refusing to recognize the legitimacy of the queen, had no scruples in replacing her names by those of the associate kings, Tuthmosis I., II. or III. In the royal lists of Sethos I. and Rameses II., Hatshepsut has no place, nor is her reign referred to on any later monument.

The immense energy of Tuthmosis III. now found its outlet in war. Syria had revolted, perhaps on Hatshepsut's death, but by his 22nd year the monarch was ready to lead his army against the rebels. Unlike his predecessors, who merely overran one after another a series of isolated city states, Tuthmosis had to face the organized resistance of a large combination, embracing the whole of western Syria and headed by the city of Kadesh on the Orontes. Six carefully planned campaigns had to be fought in order to reach and capture that city. In the 33rd year of his reign he marched through Kadesh, fought his way to Carchemish, defeated the forces that opposed him there and crossed over the Euphrates into the territory of the king of Mitanni. In all he fought 17 campaigns in Syria until the spirit of revolt was entirely crushed in a second capture of Kadesh. The wars in Libya and Ethiopia were of less moment. In the intervals of war Tuthmosis III. proved himself a wonderfully efficient administrator, with his eye on every corner of his dominions. The Syrian expeditions occupied six months in most of his best years, but the remaining time was spent in activity at home, repressing robbery and injustice, rebuilding and adorning temples with the labour of his captives and the plunder and tribute of conquered cities, or designing with his own hand the gorgeous sacred vessels of the sanctuary of Ammon. In his later years some expeditions took place into Nubia. The children of the subdued princelings in Asia and elsewhere were taken as hostages to Egypt and there educated to succeed their fathers with a due understanding of the might of Pharaoh both to protect and to punish. Thus was an empire established on a sound basis, probably for the first time in history. Tuthmosis died in the 54th year of his reign. His mummy, found in the *cachette* at Deir el Bahri is remarkable for the low forehead; yet we consider him the greatest of all the Pharaohs.

Tuthmosis III. was succeeded by his son Amenophis II., whom he had associated on the throne at the end of his reign. One of the first acts of the new king was to lead an army into Syria where revolt was again rife; he reached and perhaps crossed the Euphrates and returned home to Thebes with seven captive kings of Tikhsi and much spoil. The kings he sacrificed to Ammon and hanged six bodies on the walls, while the seventh was carried south to Napata and there exposed as a terror to the Ethiopians. Amenophis reigned 26 years and left his throne to his son, Tuthmosis IV., who is best remembered by a granite tablet recording his clearance of the Great Sphinx. He also warred in northern Syria and in Cush. His son, Amenophis III. (*c.* 1400 B.C.), was a mighty builder, especially at Thebes, where his reign marks a new epoch in the history of the great temples, Luxor being his creation, while avenues of rams, pylons, etc., were added on a vast scale to Karnak. He married a certain Taia, who, though apparently of humble parentage, was held in great honour by her husband as afterwards by her son. Amenophis III. warred in Ethiopia, but his sway was long unquestioned from Napata to the Euphrates. Small objects with his name and that of Taia are found on the mainland and in the islands of Greece. Through the fortunate discovery of cuneiform tablets deposited by his successor in the archives at Tell el-Amarna, we can see how the rulers of the great kingdoms beyond

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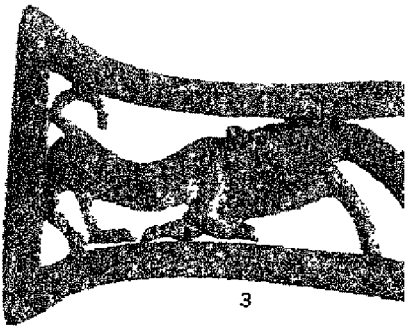

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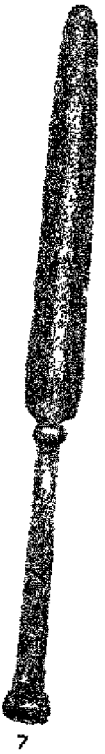

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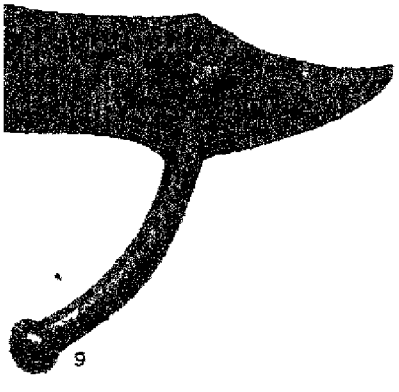
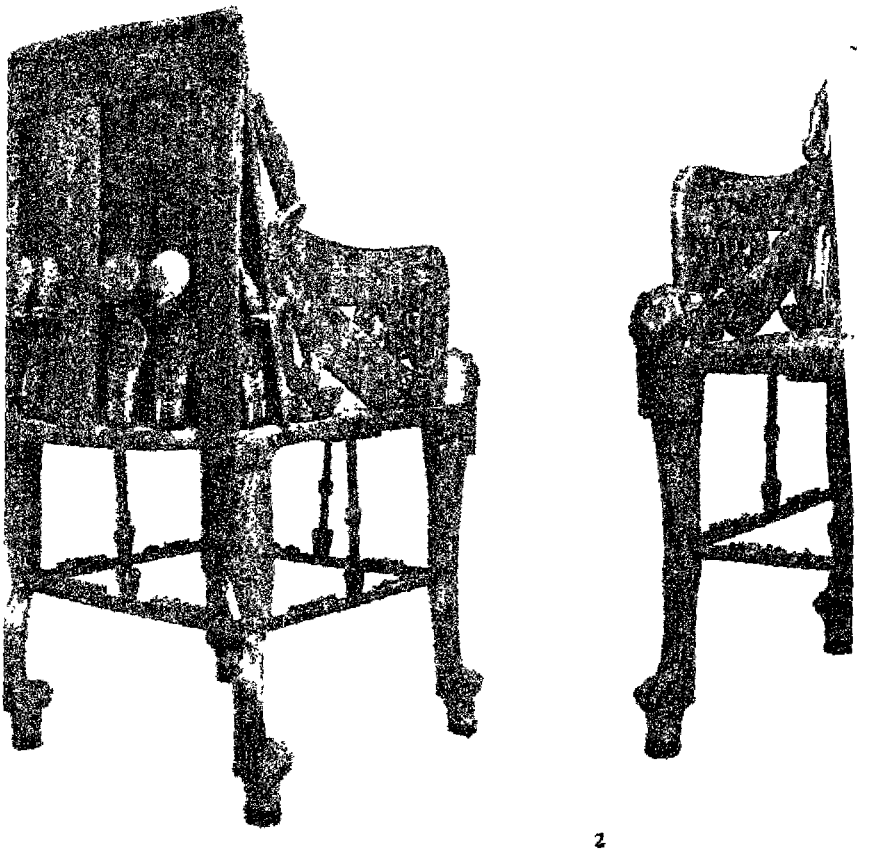


9

THE BRITISH MUSEUM. (8) CARTER, FROM "THE TOMB OF TUT'-ANAH-AMEN"

EGYPTIAN TOOLS AND WEAPONS

nasty, 1350 B.C. 2. Dagger with 2000 B.C.). 3. Bronze axe-blade, ng gazelle. 4. Bronze dagger; haft 1550 B.C.). 5. Axe with open-work blade, in original hafting; 18th dynasty. 6 Pole-axe with probable date *c.* 2700 B.C. 7. Cast of ceremonial spear-head *c.* 1600 B.C. 8. Iron dagger 18th dynasty. Decorated k ob of rock crystal. 9. Bronze razor; probably of 18th dy



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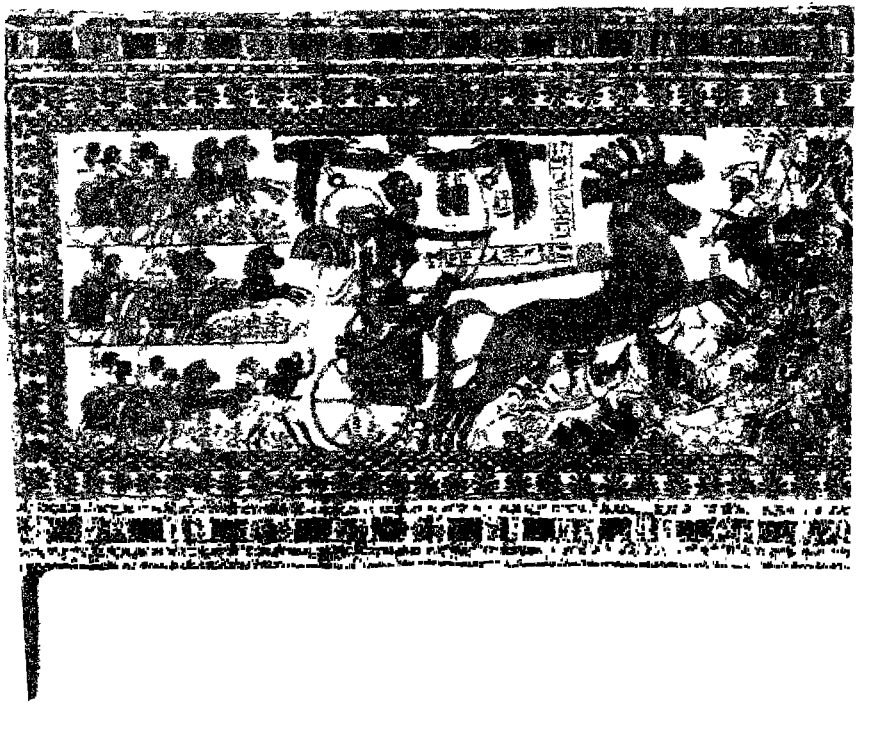

FURNITURE FROM TOMB OF TUTANKHAMUN (c. 1400 B

1. A state chair of wood, overlaid with gold and richly decorated ...th carving. On the back and sides are patterns of papyrus rushes ...d water fowl in low relief. The lions' heads are of chased gold. ...ankhamun and his queen are ... the pane

3. Casket of wood covered wi... representing Tuta khamu... The paint ngs are fu... g eater artist c treasu...

The kings of Mitanni, Assyria and even Babylon also corresponded with Amenophis, gave their daughters to him in marriage and congratulated themselves on having his friendship. Within the empire the descendants of the Syrian dynasts conquered by his father, having been educated in Egypt, ruled their paternal possessions as the abject slaves of Pharaoh. A constant stream of tribute poured into Egypt, sufficient to defray the cost of all the splendid works that were executed. Amenophis caused a series of large scarabs unique in their kind to be engraved with the name and parentage of his queen Taia, followed by varying texts commemorating like medals the boundaries of his kingdom, his secondary marriage with Gilukhipa, daughter of the king of Mitanni, the formation of a sacred lake at Thebes, a great hunt of wild cattle, and the number of lions the king slew in the first ten years of his reign. The colossi known to the Greeks by the name of the Homeric hero Memnon which look over the western plain of Thebes, represent this king and were placed before the entrance of his funerary temple, the rest of which has disappeared. His palace lay farther south on the west bank, built of crude brick covered with painted stucco. Towards the end of his reign of 36 years, Syria was invaded by the Hittites from the north and the people called Khabiri from the eastern desert; some of the kinglets conspired with the invaders to overthrow the Egyptian power, while those who remained loyal sent alarming reports to their sovereign.

Amenophis IV., son of Amenophis III. and Taia, was perhaps the most remarkable character in the long line of the Pharaohs. He was a religious fanatic, who had probably been high priest of the sun-god at Heliopolis, and had come to view the sun as the visible source of life, creation, growth and activity, whose power was demonstrated in foreign lands almost as clearly as in Egypt. Thrusting aside all the multitudinous deities of Egypt and all the mythology even of Heliopolis, he devoted himself to the cult of the visible sun-disc, applying to it as its chief name the hitherto rare word Aton, meaning "sun"; the traditional divine name Harakht (Horus of the horizon), given to the hawk-headed sun-god of Heliopolis, was however allowed to subsist and a temple was built at Karnak to this god. The worship of the other gods was officially recognized until his fifth year, but then a sweeping reform was initiated by which apparently the new cult alone was permitted. Of the old deities Ammon represented by far the wealthiest and most powerful interests, and against this long-favoured deity the Pharaoh hurled himself with fury. He changed his own name from Amenhotep, "Ammon is satisfied," to Ikhnaton, "pious to Aton," erased the name and figure of Ammon from the monuments, even where it occurred as part of his own father's name, abandoned Thebes, the magnificent city of Ammon, and built a new capital at El Amarna in the plain of Hermopolis, on a virgin site upon the edge of the desert. This with a large area around he dedicated to Aton in the sixth year while splendid temples, palaces, houses and tombs for his god, for himself and for his courtiers were rising around him. In all local temples the worship of Aton was instituted. The confiscated revenues of Ammon and the tribute from Syria and Cush provided ample means for adorning Akhetaton, "the horizon of Aton," the new capital, and for richly rewarding those who adopted the Aton teaching fervently. But meanwhile the political needs of the empire were neglected; the dangers which threatened it at the end of the reign of Amenophis III. were never properly met; the dynasts in Syria were at war amongst themselves, intriguing with the great Hittite advance and with the Khabiri invaders. Those who relied on Pharaoh and remained loyal as their fathers had done sent letter after letter appealing for aid against their foes. But though a general was despatched with some troops, he seems to have done more harm than good in misjudging the quarrels. At length the tone of the letters becomes one of despair, in which flight to Egypt appears the only resource left for the adherents of the Egyptian cause. Before the end of the reign Egyptian rule in Syria had probably ceased altogether. Ikhnaton died in or about the 17th year of his reign, *c.* 1350 B.C. He had a family of daughters who appeared constantly with him in all ceremonies, but no son. Two sons-in-law, mere boys, followed him with brief reigns, but the second, Tutankhaton, soon changed his name to Tutankhamun and without abandoning Akhetaton entirely began to restore to Karnak its ancient splendour, with new monuments dedicated to Ammon. Ikhnaton's reform had not reached deep amongst the masses of population; they probably retained all their old religious customs and superstitions while the priesthoods throughout the country must have been fiercely opposed to the heretic's work, even if silenced during his lifetime by force and bribes. Tutankhamun died after six years of reign and was buried at Thebes in the famous tomb which Lord Carnarvon and Howard Carter found still packed with its precious furniture. One more adherent of Ikhnaton, a priest named Ay ruled for a short time. At length a soldier Haremhab, came to the throne as a whole-hearted supporter of the old religion without the heretical family taint of his predecessors; soon Aton and the whole of his royal following suffered the fate they had imposed upon Ammon; their monuments were destroyed and their names and figures erased, while those of Ammon were restored. From the time of Rameses II. onwards the years of the reigns of the heretics were counted to Haremhab, and Ikhnaton was described as "that criminal of Akhetaton." Haremhab had to bring order as a practical man into the long-neglected administration of the country and to suppress the extortions of the official classes by severe measures. His laws to this end were engraved on a great stela in the temple of Karnak, of which sufficient remains to bear witness to his high aims, while the prosperity of the succeeding reigns shows how well he realized the necessities of the state. He probably began also to re-establish the prestige of Egypt by military expeditions in the surrounding countries.

Haremhab appears to have legitimated his rule by marriage to a royal princess, but it is probable that Rameses I. who succeeded as founder of the 19th dynasty, was not closely related to him. Rameses in his brief reign of two years planned and began the great colonnaded hall of Karnak. His son, Seti I., having subdued the Bedouin Shasu, who had invaded Palestine and withheld all tribute, proceeded to the Lebanon. Here cedars were felled for him by the Syrian princes, and the Phoenicians paid homage before he returned home in triumph. The Libyans had also to be dealt with, and afterwards Seti advanced again through Palestine, ravaged the land of the Amorites and came into conflict with the Hittites. The latter, however, were now firmly established in the Orontes valley, and a treaty with Mutallu, the king of Kheta, reigning far away in Cappadocia, probably ended the wars of Seti. In his ninth year he turned his attention to the gold-mines in the eastern desert of Nubia and improved the road thither. Meanwhile the great work at Karnak projected by his father was going forward, and throughout Egypt the injuries done to the monuments by Ikhnaton were thoroughly repaired; the erased inscriptions and figures were restored, not without many blunders. Seti's temple at Abydos and his galleried tomb in the Valley of the Tombs of the Kings stand out as the most splendid examples of their kind in design and in decoration. Rameses II. succeeded at an early age and reigned 67 years, during which he finished much that was begun by Seti and filled all Egypt and Nubia with his own monuments, some of them beautiful but most, necessarily entrusted to inferior workmen, of coarse execution. The excavation of the rock temple of Abu Simbel and the completion of the great hall of Karnak were his greatest achievements in architecture. His wars began in his second year, their field comprising the Nubians, the Libyans, the Syrians and the Hittites. In his fifth year, near Kadesh on the Orontes, his army was caught unprepared and divided by a strong force of chariots of the Hittites and their allies, and Rameses himself was placed in the most imminent danger; but through his personal courage the enemy was kept at bay till reinforcements came up and turned the disaster into a victory. The incidents of this episode were a favourite subject in the sculptures of his temples, where their representation was accompanied by a poetical version of the affair and other explanatory inscriptions. Kadesh, however, was not captured, and after further contests, in his 21st year, Rameses and the Hittite king Khattusil (Kheta-sar) made peace, with a defensive alliance against foreign aggression and internal revolt (*see* HITTITES). In the 34th year, *c.* 1250 B.C., Khattusil with his friend or subject, the king of Kode, came from his distant capital to see the wonders of Egypt in person, bringing one of

daughters to be wife of the splendid Pharaoh. Rameses II. paid much attention to the Delta, which had been neglected until the time of Seti I., and resided there constantly, the temple of Tanis must have been greatly enlarged and adorned by him: a colossus of the king placed here was over 90ft. in height, exceeding in scale even the greatest of the Theban colossi which he had erected in his mortuary temple of the Rameseum. Towards the end of the long reign the vigilance and energy of the old king diminished. The military spirit awakened in the struggle with the Hyksos had again departed from the Egyptian nation; mercenaries from the Sudan, from Libya and from the northern nations supplied the armies, while foreigners settled in the rich lands of the Delta and harried the coasts. It was a time too when the movements of the nations that so frequently occurred in the ancient world were about to be particularly active. Mineptah, (*c.* 1225 B.C), succeeding his father Rameses II., had to fight many battles for the preservation of his kingdom and empire. Apparently most of the fighting was finished by the fifth year of his reign: in his mortuary temple at Thebes he set up a stela of that date recording a great victory over the Libyan immigrants and invaders, which rendered the much harried land of Egypt safe. The last lines picture this condition with the crushing of the surrounding tribes. Libya was wasted, the Hittites pacified, Canaan, Ashkelon, Gezer, Yenoam sacked and plundered; "Israel is desolated, his seed is not, Khor (Palestine) has become a widow (without a protector) for Egypt." The Libyans are accompanied by allies whose names, Sherden, Shekelesh, Ekwesh, Lukku, Teresh, suggest identifications with Sardinians, Sicels, Achaeans, Lycians and Tyrseni or Etruscans. The Sherden had been in the armies of Rameses II. and are distinguished by their remarkable helmets and, apparently, body armour of metal. The Lukku are certainly the same as the Lycians. Probably they were all sea-rovers from the shores and islands of the Mediterranean, who were willing to leave their ships and join the Libyans in raids on the rich lands of Egypt. Mineptah was one of the most unconscionable usurpers of the monuments of his predecessors, including those of his own father, who, it must be admitted, had set him the example. The coarse cutting of his cartouches contrasts with the splendid finish of the Middle Kingdom work which they disfigure. It may be questioned whether it was due to a wave of enthusiasm amongst the priests and people, leading them to re-dedicate the monuments in the name of their deliverer, or a somewhat insane desire of the king to perpetuate his own memory in a singularly unfortunate manner. Mineptah, the 13th son in the huge family of Rameses, must have been old when he ascended the throne; after his first years of reign his energies gave way, and he was followed by a quick succession of inglorious rulers, Seti II., the queen Tuosri Amenmesse, Siptah; the names of the last two were erased from their monuments.

A great papyrus written after the death of Rameses III. and recording his gifts to the temples briefly reviews the conditions of the troublous times which preceded his reign. "The land of Egypt was in the hands of chiefs and rulers of towns, great and small slaying each other; afterwards a certain Syrian made himself chief: he made the whole land tributary before him; he united his companions and plundered their property (*i.e.*, of the other chiefs). They made the gods like men, and no offerings were presented in the temples. But when the gods inclined themselves to peace . . they established their son Setnekht to be ruler of every land." Of the Syrian occupation we know nothing further. Setnekht (*c.* 1200 B.C.), had a very short reign and was not counted as legitimate, but he established a lasting dynasty (probably by conciliating the priesthood). He was father of Rameses III., who revived the glories of the empire. The dangers that menaced Egypt were similar to those which Mineptah had to meet at his accession. Again the Libyans and the "peoples of the sea" were acting in concert. The latter now comprised Peleset (probably Cretan ancestors of the Philistines) Thekel, Shekelesh, Denyan (Danaoi?) and Weshesh; they had invaded Syria from Asia Minor, reaching the Euphrates, destroying the Hittite cities and progressing southwards, while their ships gathered plunder from the coasts of the Delta. This fleet joined the Libyan invaders, but was overthrown with heavy loss by the [illegible] in whose ranks there actually served many Sherdan and Kehaka, Sardinian and Libyan mercenaries. Egypt itself was thus clear of enemies; but the chariots and warriors of the Philistines and their associates were advancing through Syria, their families and goods following in ox-carts, and their ships accompanying them along the shore. Rameses led out his army and fleet against them and struck them so decisive a blow that the migrating swarm submitted to his rule and paid him tribute. In his 11th year another Libyan invasion had to be met, and his suzerainty in Palestine forcibly asserted. His vigour was equal to all these emergencies and the later years of his reign were spent in peace. Rameses III., however, was not a great ruler. He was possessed by the spirit of decadence, imitative rather than originating. It is evident that Rameses II was the model to which he endeavoured to conform, and he did not attempt to preserve himself from the weakening influences of priestcraft. To the temples he not only restored the property which had been given to them by former kings, but he also added greatly to their wealth, the Theban Ammon receiving by far the greatest share. The land held in the name of different deities is estimated at about 15% of the whole of Egypt; various temples of Ammon owned two-thirds of this, Rē of Heliopolis and Ptah of Memphis being next in wealth. His palace was at Medinet Habu on the west bank of Thebes in the south quarter; and here he built a great temple to Ammon adorned with scenes from his victories and richly provided with divine offerings. Shortly before the death of the old king a plot in the harem to assassinate him and apparently to place one of his sons on the throne, was discovered and its investigation ordered leading after his death to the condemnation of many high-placed men and women. Nine kings of the name of Rameses now followed each other ingloriously in the space of about 80 years to the end of the 20th dynasty, the power of the high priests of Ammon ever growing at their expense. The Libyans began again their encroachments, and there was undoubtedly great distress amongst certain portions of the population. We read in a papyrus of a strike of starving labourers in the Theban necropolis who would not work until corn was given to them, and apparently the government storehouse was empty at the time, perhaps in consequence of a bad Nile. At this time the Theban necropolis was being more systematically robbed than ever before. Under Rameses IX an investigation took place which showed that one of the royal tombs before the western cliffs had been completely ransacked and the mummies burnt. Three years later the Valley of the Tombs of the Kings was attacked and the sepulchres of Seti I. and Rameses II. were robbed. The authority of the last king of the 20th dynasty, Rameses XII., was shadowy. Hrihor, the high priest, gathered into his own hands the real power, and succeeded him at Thebes, *c.* 1100 B.C.

The Libyan Dynasties in the Delta.—At this juncture a prince at Tanis named Smendes, (Esbentêti) founded a separate dynasty in the Delta (21st dynasty). From this period dates a remarkable papyrus containing the report of an envoy named Unamûn, sent to Syria by Hrihor with a recommendation to Smendes, in order to obtain cedar timber from Byblus; Unamûn learned to his cost that the ancient prestige of Egypt in Syria had entirely disappeared. The Tanite line of kings generally had the overlordship of the high priests of Thebes; the descendants of Hrihor, however, sometimes by marriage with princesses of the other line, could assume cartouches and royal titles, and in some cases perhaps ruled the whole of Egypt. Ethiopia may have been ruled with the Thebais, but the records of the time are very scanty. The mummies from the despoiled tombs of the kings were the object of much anxious care to the kings of this dynasty, after being removed from one tomb to another, they were finally deposited in a shaft near the temple of Deir el Bahri, where they remained till our day. Eventually these royal mummies were all secured for the Cairo museum.

Libyan soldiers had long been employed in the army, and their military chiefs settled in the large towns and acquired wealth and power, while the native rulers grew weaker and weaker. The Tanite dynasty may have risen from a Libyan stock, though there is nothing to prove it: the 22nd dynasty are clearly from their names of foreign e[illegible]ion and their genealogy indicates distinctly a Lib-

var military origin in a family of rulers of Heracleopolis Magna in Middle Egypt. Sheshonk (Shishak) I., the founder of the dynasty, (c 950 B.C.), seems to have fixed his residence at Bubastis in the Delta, and his son married the daughter of the last king of the Tanite dynasty. Heracleopolis seems henceforth for several centuries to have been capital of Middle Egypt, which was considered as a more or less distinct province. Sheshonk secured Thebes, making one of his sons high priest of Ammon, and whereas Solomon appears to have dealt with a king in Egypt on something like an equal footing, Sheshonk re-established Egyptian rule in Palestine and Nubia and his expedition in the fifth year of Rehoboam subdued Israel as well as Judah, to judge by the list of city names which he inscribed on a wall of the temple of Karnak. Osorkon I. inherited a prosperous kingdom from his father, but no further progress was made. It required a strong hand to curb the Libyan chieftains, and divisions soon began to show themselves in the kingdom. The 22nd dynasty lasted through many generations; but there were rival kings, and it seems that the 23rd dynasty was contemporaneous with the end of the 22nd. The kings of the 23rd dynasty had little hold upon the subject princes, who spent the resources of the country in feuds amongst themselves. A separate kingdom had meanwhile been established in Ethiopia, probably under a Libyan chieftain. Our first knowledge of it is at this moment, when the Ethiopian king Pankhi, already held the Thebais. The energetic prince of Sais, Tefnakht, followed by most of the princes of the Delta, subdued most of Middle Egypt, and by uniting these forces, threatened the Ethiopian border. Heracleopolis Magna, however, with its petty king Pefteuaubasti, held out against Tefnakht, and Pankhi coming to its aid not only drove Tefnakht out of Middle Egypt, but also captured Memphis and received the submission of the princes and chiefs; in all, these included four "kings" and fourteen other chiefs. According to Diodorus the Ethiopian state was theocratic, ruled through the king by the priests of Ammon. The account is probably exaggerated; but even in Pankhi's record the piety of the king, especially towards Ammon, is very marked.

The 24th dynasty consisted of a single Saite king named Bocchoris (Bekerrinf), son of Tefnachthus, apparently the above Tefnakht. Another Ethiopian invader, Shabako (Sabacon) is said to have burnt Bocchoris alive.[1] The Ethiopian rule of the 25th dynasty was now firmly established, and the resources of the two countries together might have been employed in conquest of Syria and Phoenicia; but at this very time the Assyrian empire, risen to the highest pitch of military greatness, began to menace Egypt. The Ethiopian could do no more than encourage or support the Syrians in their fight for freedom against Sargon and Sennacherib. Shabako was followed by Shebitku and Shebitku by Tirhaka. Tirhaka was energetic in opposing the Assyrian advance, but in 671 B.C., Esarhaddon defeated his army on the border of Egypt, captured Memphis with the royal harem and took great spoil. The Egyptian resistance to the Assyrians was probably only half-hearted in the north especially there must have been a strong party against Ethiopian rule. Tirhaka laboured to propitiate the north country, and probably rendered the Ethiopian rule more acceptable throughout Egypt. Notwithstanding, the Assyrian king entrusted the Government and collection of tribute to the native chiefs; twenty princes in all are enumerated in the records, including one Assyrian to hold the key of Egypt at Pelusium. Scarcely had Esarhaddon withdrawn before Tirhaka returned from his refuge in the south and the Assyrian garrisons were massacred. Esarhaddon promptly prepared a second expedition, but died on the way to Egypt in 668 B.C.; his son, Assur-bani-pal sent it forward, routed Tirhaka and reinstated the governors. At the head of these was Necho (Niku), king of Sais and Memphis, father of Psammetichus, who founded the 26th dynasty, and no doubt was related to Bocchoris and Tefnakht, the victims of Ethiopian invasion. We next hear that correspondence with Tirhaka was intercepted, and that Necho, together with Pekrûr of Psapt (at the entrance to the Wadi Tumilat) and the Assyrian governor of Pelusium, was taken to Nineveh in chains to answer the charge of treason. Whatever may have occurred, it was deemed politic to send Necho back loaded with honours and surrounded by a retinue of Assyrian officials. Upper Egypt, however, was loyal to Tirhaka, and even at Memphis the burial of an Apis bull was dated by the priests as in his reign. Immediately afterwards he died. His nephew Tandamane, received by the upper country with acclamations, besieged and captured Memphis, Necho being probably slain in the encounter. But in 661 (?) Assur-bani-pal drove the Ethiopian out of Lower Egypt, pursued him up the Nile and sacked Thebes. This was the last and most tremendous visitation of the Assyrian scourge. All the Ethiopian kings from Pankhi to Tandamane were buried in pyramids at their ancestral home at Napata.

Psammetichus (Psamêtk), 664–610 B.C., the son of Necho, succeeded his father as a vassal of Assyria in his possessions of Memphis and Sais, allied himelf with Gyges, king of Lydia, and aided by Ionian and Carian mercenaries, extended and consolidated his power.[1] By the ninth year of his reign he was in full possession of Thebes. Assur-bani-pal's energies throughout this crisis were entirely occupied with revolts nearer home, in Babylon, Elam and Arabia. The Assyrian armies triumphed everywhere, but at the cost of complete exhaustion. Under the firm and wise rule of Psammetichus, Egypt recovered its prosperity after terrible losses inflicted by internal wars and the decade of the Assyrian invasions. The revenue went up by leaps and bounds. Psammetichus guarded the frontiers of Egypt with three strong garrisons, placing the Ionian and Carian mercenaries especially at the Pelusian Daphnae in the north-east, from which quarter the most formidable enemies were likely to appear. A great Scythian horde, destroying all before it in its southward advance, is said by Herodotus to have been turned back by presents and entreaties. Diplomacy backed up by vigorous preparations may have deterred the Scythians from the dangerous enterprise of crossing the desert to Egypt. Towards the end of his reign he loyally sent support to the Assyrians against the attacks of the Medes and Babylonians.

When Psammetichus began to reign, the situation of Egypt was very different from what it had been under the empire. The development of trade in the Mediterranean and contact with new peoples and new civilizations in peace and war had given birth to new ideas among the Egyptians and at the same time to a loss of confidence in their own powers. The Theban supremacy was gone and the Delta was now the wealthy and progressive part of Egypt, piety increased amongst the masses, unenterprising and unwarlike, but proud of their illustrious antiquity. The Ethiopians had already turned for their models to the times of the ancient supremacy of Memphis, and the sculptures and texts on tomb and temple were made to conform as closely as possible to those of the Old Kingdom. In non-religious matters, however, the Egyptians were inventing and perhaps borrowing. To enumerate a few examples of this which are already definitely known: we find that the forms of legal and business documents became more precise; the mechanical arts of casting in bronze on a core and of moulding figures and pottery were brought to the highest pitch of excellence; and portraiture in the round on its highest plane was better than ever before, and admirably lifelike, revealing careful study of the external anatomy of the individual.

Psammetichus died in the 54th year of his reign and was succeeded by his son Necho, 610–594 B.C. The Assyrians finally succumbed in 610 and the new Pharaoh prepared an expedition to recover the long-lost possessions of the Egyptian empire in Syria. Josiah alone opposed him with his feeble force at Megiddo and was easily overcome and slain. Necho went forward to the Euphrates, put the land to tribute and, in the case of Judah at any rate, filled the throne with his own nominee (*see* JEHOIAKIM). The division of the Assyrian spoil gave its inheritance in the west to Nabopolasser, king of Babylon, who soon despatched his son Nebuchadrezzar to fight Necho. The Babylonian and Egyptian forces met at Carchemish (605), and the rout of the latter was so complete that Necho relinquished Syria and might have lost Egypt as well had not the death of Nabopolasser recalled

[1]Bocchoris is represented by Mycerinus in Herodotus, but confused with Menkeure of the 14th dynasty, whose name is correctly rendered as Mencheres by Manetho

[1]This, it may be remarked, is the time vaguely represented by the archy of Herodotus

the visit to Babylon. Herodotus relates that in Necho's reign a Phoenician ship despatched from Egypt actually circumnavigated Africa, and the attempt was made to complete a canal through the Wadi Tumilat connecting the Mediterranean and the Red Sea by way of the Lower Egyptian Nile (*see* SUEZ). The next king, Psammetichus II., 594–589 B.C., according to one account, visited Syria or Phoenicia, and apparently sent a mercenary force into Ethiopia as far as Abu Simbel. Pharaoh Hophra (Apries), 589–570 B.C., fomented rebellion against the Babylonian suzerainty in Judah, but accomplished little there. Herodotus, however, describes his reign as exceedingly prosperous. The mercenary troops at Elephantine mutinied and attempted to desert to Ethiopia, but were brought back and punished. Later, however, a disastrous expedition sent to aid the Libyans against the Greek colony of Cyrene roused the suspicion and anger of the native soldiery at favours shown to the mercenaries, who of course had taken no part in it. Amasis (Ahmosi) II. was chosen king by the former (570–525 B.C.) and his swarm of adherents overcame the Greek troops in Apries' pay. None the less Amasis employed Greeks in numbers, and cultivated the friendship of their tyrants. His rule was confined to Egypt (and perhaps Cyprus), but Egypt itself was very prosperous. At the beginning of his long reign of 44 years he was threatened by Nebuchadrezzar; later he joined the league against Cyrus and saw with alarm the fall of his old enemy. A few months after his death, 525 B.C., the invading host of the Persians led by Cambyses reached Egypt and dethroned his son Psammetichus III.

Cambyses at first conciliated the Egyptians and respected their religion; but, perhaps after the failure of his expedition into Ethiopia, he entirely changed his policy. He left Egypt so completely crushed that the subsequent usurpation of the Persian throne was marked by no revolt in that quarter. Darius, 521–486 B.C., proved himself a beneficent ruler, and in a visit to Egypt displayed his consideration for the religion of the country. In the great oasis he built a temple to Ammon. The annual tribute imposed on the satrapy of Egypt and Cyrene was heavy, but it was probably raised with ease. The canal from the Nile to the Red sea was completed or repaired, and commerce flourished. Documents dated in the 34th and 35th years of Darius are not uncommon, but apparently at the very end of his reign, some years after the disaster of Marathon, Egypt was induced to rebel. Xerxes (486–467 B.C.), who put down the revolt with severity, and his successor Artaxerxes (466–425 B.C.), like Cambyses, were hateful to the Egyptians. The disorders which marked the accession of Artaxerxes gave Egypt another opportunity to rebel. The leaders were Inaros, the Libyan of Marea, and the Egyptian Amyrtaeus. Aided by an Athenian force, Inaros slew the satrap Achaemenes at the battle of Papremis and destroyed his army; but the garrison of Memphis held out, and a fresh host from Persia raised the siege and in turn besieged the Greek and Egyptian forces on the island of Papremis. At last, after two years, having diverted the river from its channel, they captured and burnt the Athenian ships and quickly ended the rebellion. The reigns of Xerxes II. and Darius II. are marked by no recorded incident in Egypt until a successful revolt about 405 B.C. interrupted the Persian domination.

Monuments of the Persian rule in Egypt are exceedingly scanty. The inscription of Pefteuaueit, priest of Neith at Sais and from his position the native authority who was most likely to be consulted by Cambyses and Darius, tells of his relations with these two kings. For the following reigns Egyptian documents hardly exist, but some papyri written in Aramaic have been found at Elephantine and at Memphis. Those from the former locality show that a colony of Jews with a temple dedicated to Yahweh (Jehovah) had established themselves at that garrison and trading post (*see* ASWAN). Herodotus visited Egypt in the reign of Artaxerxes, about 440 B.C. His description of Egypt, partly founded on Hecataeus, who had been there about 50 years earlier, is the chief source of information for the history of the Saite kings and for the manners of the times, but his statements prove to be far from correct when they can be checked by the scanty native evidence.

Amyrtaeus (Amnertais) of Sais, perhaps a son of Pausiris and grandson of the earlier Amyrtaeus, revolted from Darius II., *c.* 405 B.C., and Egypt regained its independence for about 60 years. The next king, Nefeurēt (Nepherites I.) was a Mendesian and founded the 29th dynasty. After Hakor and Nefeurēt II. the sovereignty passed to the 30th Dynasty, the last native Egyptian line. Monuments of all these kings are known and art flourished particularly under the Sevennyte kings Nekhtnebf and Nekhtharheb (Nectanebes I. and II.). The former came to the throne when a Persian invasion was imminent, 379 B.C. Hakor had already formed a powerful army, largely composed of Greek mercenaries. This army Nekhtnebf entrusted to the Athenian Chabrias. The Persians, however, succeeded in causing his recall and in gaining the services of his fellow-countryman Iphicrates. The invading army consisted of 200,000 barbarians under Pharnabazus and 20,000 Greeks under Iphicrates. After the Egyptians had experienced a reverse, Iphicrates counselled an immediate advance on Memphis. His advice was not followed by Pharnabazus; the Egyptian king collected his forces and won a pitched battle near Mendes. Pharnabazus retreated and Egypt was free.

Nekhtnebf was succeeded by Tachos or Teos, whose short reign was occupied by a war with Persia, in which the king of Egypt secured the services of a body of Greek mercenaries under the Spartan king Agesilaus and a fleet under the Athenian general Chabrias. He entered Phoenicia with every prospect of success, but having offended Agesilaus he was dethroned in a military revolt which gave the crown to Nekhtharheb; but a large Egyptian party supported a prince of Mendes, who was probably named Khebobesh, and almost succeeded in overthrowing the new pharaoh. Agesilaus defeated the rival pretender and left Nekhtharheb established on the throne; but the opportunity of a decisive blow against Persia was lost. The new king Artaxerxes III. Ochus, determined to reduce Egypt. A first expedition was defeated by the Greek mercenaries of Nekhtharheb, but a second, commanded by Ochus himself, subdued Egypt with no further resistance than that of the Greek garrison of Pelusium. Nekhtharheb, last of the native pharaohs, instead of endeavouring to relieve them retreated to Memphis and fled thence to Ethiopia, 341 (?) B.C.

Ochus treated his conquest barbarously. From this brief re-establishment of Persian dominion (counted by Manetho as the 31st dynasty) no document survives except one papyrus that appears to be dated in the reign of Darius III.

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The Conquest by Alexander.—When in 332 B.C., after the battle of Issus, Alexander entered Egypt, he was welcomed as a deliverer. The Persian governor had not forces enough to oppose him and he nowhere experienced even the show of resistance. He visited Memphis, founded Alexandria, and went on pilgrimage to the oracle of Ammon (Oasis of Siwa). The god declared him to be his son, renewing thus an old Egyptian convention or belief; Olympias was supposed to have been in converse with Ammon, even as the mothers of Hatshepsut and Amenophis III. are represented in the inscriptions of the Theban temples to have received the divine essence. At this stage of his career the treasure and tribute of Egypt were of great importance to the Macedonian conqueror. He conciliated the inhabitants by the respect which he showed for their religion; he organized the government of the natives under two officers, who must have been already known to them (of these Petisis, an Egyptian, soon resigned his share into the charge of his colleague Doloaspis, who bears a Persian name). But Alexander designed his Greek foundation of Alexandria to be

[illegible] and entrusted the taxation of Egypt and the control of [illegible] army and navy to Greeks. Early in 31 B.C. he was ready to depart and led his forces away to Phoenicia. A granite gateway to the temple of Khnūm at Elephantine bears his name in hieroglyphic, and demotic documents are found dated in his reign.

The Ptolemaic Period.—On the division of Alexander's dominions in 323 B.C., Egypt fell to Ptolemy, the son of Lagus, the founder of the Ptolemaic dynasty (*see* PTOLEMIES). Under these rulers the rich kingdom was heavily taxed to supply the sinews of war and to support every kind of lavish expenditure. Officials, and the higher ones were nearly all Greeks, were legion, but the whole system was so judiciously worked that there was little discontent amongst the patient peasantry. During the reign of Philadelphus the land gained from the bed of the lake of Moeris was assigned to veteran soldiers; the great armies of the Ptolemies were rewarded or supported by grants of farm lands, and men of Macedonian, Greek and Hellenistic extraction were planted in colonies and garrisons or settled themselves in the villages throughout the country. Upper Egypt, farthest from the centre of government at Alexandria, was probably least affected by the new influences, though the first Ptolemy established the Greek colony of Ptolemais to be its capital. Intermarriages, however, gradually had their effect; after the revolt in the reigns of Ptolemy IV. and V. we find the Greek and Egyptian elements closely intermingled. Ptolemy I. had established the cult of the Memphite Serapis in a Graeco-Egyptian form, affording a common ground for native and Hellenistic worshippers, and endless temples to the native deities were built or re-built under the Ptolemies. No serious effort was made to extend the Ptolemaic rule into Ethiopia, and Ergamenes, the Hellenizing king of Ethiopia, was probably in alliance with Philopator, in the last year of Philopator (Ptolemy IV.), 204 B.C., came the great native revolt which continued through most of the reign of Epiphanes and affected the whole country. Down to 186 B.C. Harmakhis and Ankhmakhis native kings supported by Ethiopia reigned in succession at Thebes, and two years later there was still trouble in Lower Egypt. Thebes lost all except its religious importance under the Ptolemies; after the "destruction" or dismantling by Lathyrus (Ptolemy X.) it formed only a series of villages. The population of Egypt in the time of Ptolemy I. is put at 7,000,000 by Diodorus, who also says that it was greater then than it ever was before; at the end of the dynasty, in his own day, it was not much less, though somewhat diminished. It is remarkable that, while the building and decoration of temples continued in the reigns of Ptolemy Auletes (XIII.), Cleopatra, etc., papyri of those times, whether Greek or Egyptian, are scarcely to be found.

The Roman Period.—In 30 B.C. Augustus took Egypt as the prize of conquest. He treated it as a part of his personal domain, free from any interference by the senate. In the main lines the Ptolemaic organization was preserved, but Romans were gradually introduced into the highest offices. On Egypt Rome depended for its supplies of corn; entrenched there, a revolting general would be difficult to attack, and by simply holding back the grain ships could threaten Rome with starvation. No senator, therefore, was permitted to take office or even to set foot in the country without the emperor's special leave, and by way of precaution the highest position, that of prefect, was filled by a Roman of equestrian rank only. As the representative of the emperor, this officer assumed the place occupied by the king under the old order, except that his power was limited by the right of appeal to Caesar. The first prefect, Cornelius Gallus, tamed the natives of Upper Egypt to the new yoke by force of arms, and meeting ambassadors from Ethiopia at Philae, established a nominal protectorate of Rome over the frontier district, which had been abandoned by the later Ptolemies. The third prefect, Gaius Petronius, cleared the neglected canals for irrigation; he also repelled an invasion of the Ethiopians and pursued them far up the Nile, finally storming the capital of Napata. But no attempt was made to hold Ethiopia and the boundary of the empire was fixed 70 miles south of the First Cataract, the limit of the Dodecaschoenus. In succeeding reigns much trouble was caused by jealousies and quarrels between the Greeks and the Jews, to whom Augustus had granted privileges as valuable as those conceded the Greeks. [illegible] trade, Aelius Gallus, the second prefect of Egypt under Augustus, had made an unsuccessful expedition to conquer Arabia Felix; the valuable Indian trade, however, was secured by Claudius for Egypt at the expense of Arabia, and the Red Sea routes were improved. Nero's reign especially marks the commencement of an era of prosperity which lasted about a century. Under Vespasian the Jewish temple at Leontopolis in the Delta, which Onias had founded in the reign of Ptolemy Philometor, was closed; worse still, a great Jewish revolt and massacre of the Greeks in the reign of Trajan resulted after a stubborn conflict of many months with the Roman army under Marcius Livianus Turbo, in the virtual extermination of the Jews in Alexandria and the loss of all their privileges. Hadrian, who twice visited Egypt (A.D. 130, 134), founded Antinoë in memory of his drowned favourite. From this reign onwards buildings in the Graeco-Roman style were erected throughout the country. A new Sothic cycle began in A.D. 139. Under Marcus Aurelius a revolt of the Bucolic or native troops recruited for home service was taken up by the whole of the native population and was suppressed only after several years of fighting. The Bucolic war caused infinite damage to the agriculture of the country, and marks the beginning of its rapid decline under a burdensome taxation. The province of Africa was now of equal importance with Egypt for the grain supply of the capital. Avidius Cassius, who led the Roman forces in the war, usurped the purple and was acknowledged by the armies of Syria and Egypt. On the approach of Marcus Aurelius, the adherents of Cassius slew him, and the clemency of the emperor restored peace. After the downfall of the house of the Antonines, Pescennius Niger, who commanded the forces in Egypt, was proclaimed emperor on the death of Pertinax (A.D. 193). Severus overthrew his rival (A.D. 194) and, the revolt having been a military one, did not punish the province; in 202 he gave a constitution to Alexandria and the "nome" capitals. In his reign the Christians of Egypt suffered the first of their many persecutions.

Caracalla, in revenge for an affront, massacred all the men capable of bearing arms in Alexandria. His granting of the Roman citizenship to all Egyptians in common with the other provincials was only to extort more taxes. Under Decius (A.D. 250) the Christians again suffered from persecution. When the empire broke up in the weak reign of Gallienus, the prefect Aemilianus, who took the surname Alexander or Alexandrinus, was made emperor by the troops at Alexandria, but was conquered by the forces of Gallienus. In his brief reign of only a few months he had driven back an invasion of the Blemmyes. This predatory tribe, issuing from Nubia, was long to be the terror of Upper Egypt. Zenobia, queen of Palmyra, after an unsuccessful invasion, on a second attempt conquered Egypt, which she added to her empire, but lost it when Aurelian made war upon her (A.D. 272). The province was, however, unsettled, and the conquest of Palmyra was followed in the same year by the suppression of a revolt in Egypt (A.D. 273). Probus, who had governed Egypt for Aurelian and Tacitus, was subsequently chosen by the troops to succeed Tacitus, and is the first governor of this province who obtained the whole of the empire. He expelled the Blemmyes, who were dominating the whole of the Thebaid. Diocletian invited the Nobatae to settle in the Dodecaschoenus as a barrier against their incursions, and subsidized both Blemmyes and Nobatae. The country, however, was still disturbed, and in A.D. 296 a formidable revolt broke out, led by Achilleus, who as emperor took the name Domitius Domitianus. Diocletian, finding his troops unable to determine the struggle, came to Egypt, captured Alexandria, and put his rival to death (296). He then reorganized the whole province, and the well-known "Pompey's Pillar" was set up by the grateful and repentant Alexandrians to commemorate his gift to them of part of the corn tribute.

The Coptic era of Diocletian or of the Martyrs dates from the accession of Diocletian (A.D. 284). The edict of A.D. 303 against the Christians, and those which succeeded it, were rigorously carried out in Egypt, where Paganism was still strong and face to face with a strong and united church. Galerius, who succeeded Diocletian in the government of the East implacably pursued his

policy and this great persecution did not end until the persecutor, perishing, it is said, of the dire malady of Herod and Philip II of Spain, sent out an edict of toleration (A.D. 311).

At the Council of Nicaea the most conspicuous controversialist on the Orthodox side was the young Alexandrian deacon Athanasius, who returned home to be made archbishop of Alexandria (A.D. 326). After being four times expelled by the Arians and once by the Emperor Julian, he died A.D. 373, at the moment when an Arian persecution began. So large a proportion of the population had taken religious vows that under Valens it became necessary to abolish the privilege of monks which exempted them from military service. The reign of Theodosius I. witnessed the overthrow of Arianism, and this was followed by the suppression of Paganism, against which a final edict was promulgated A.D. 390. In Egypt, the year before, the temple of Serapis at Alexandria had been captured after much bloodshed by the Christian mob and turned into a church. Cyril, the patriarch of Alexandria (A.D. 415), expelled the Jews from the capital with the aid of the mob, and murdered the beautiful philosopher Hypatia. A schism now produced lengthened civil war and alienated Egypt from the empire. The distinction between religion and politics seemed to be lost, and the government grew weaker and weaker. The system of local government by citizens had entirely disappeared. Offices, with new Byzantine names, were now almost hereditary in the wealthy land-owning families. The Greek rulers of the Orthodox faith were unable to protect the tillers of the soil, and these being of the Monophysite persuasion and having their own church and patriarch, hated the Orthodox patriarch (who from the time of Justinian onwards was identical with the prefect) and all his following. Towards the middle of the 5th century, the Blemmyes, quiet since the reign of Diocletian, recommenced their incursions, and were even joined in them by the Nobatae. These tribes were twice brought to account severely for their misdoings, but were not effectually checked. It was in these circumstances that Egypt fell without conflict when attacked by Chosroës (A.D. 616). After ten years of Persian dominion the success of Heraclius restored Egypt to the empire, and for a time it again received a Greek governor. The Monophysites, who had taken advantage of the Persian occupation, were persecuted and their patriarch expelled. The Arab conquest was welcomed by the native Christians, but with it they ceased to be the Egyptian nation.

The decline of Egypt was due to the purely military government of the Romans, and their subsequent alliance with the Greek party of Alexandria, which never represented the country. Under weak emperors, the rest of Egypt was exposed to the inroads of savages, and left to fall into a condition of barbarism. Ecclesiastical disputes tended to alienate both the native population and the Alexandrians. Thus at last the country was merely held by force, and the authority of the governor was little recognized beyond the capital, except where garrisons were stationed. There was no military spirit in a population unused to arms, nor any disinclination to be relieved from an arbitrary and persecuting rule. Thus the Muslim conquest was easy.

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(R. S. P.; F. Ll. G.)

II. MOHAMMEDAN PERIOD

Muslim Conquest of Egypt.—Towards the end of the year 639 an army of some 4,000 men was sent against Egypt under the command of 'Amr (*see* 'AMR-IBN-EL-ASS) by the second caliph, 'Omar I. The [illegible] from Syria through El 'Arīsh, easily took Farama or Pelusium, and thence proceeded to Bilbeis, where he was delayed for a month; having captured this place, he proceeded to a point on the Nile called Umm Dunain the siege of which also occasioned him some difficulty. After taking it, he crossed the Nile to the Fayum. On June 6 of the following year (640) a second army of 12 000 men, despatched by Omar, arrived at Heliopolis (On). 'Amr recrossed the river and joined it, but presently was confronted by a Roman army, which he defeated at the battle of Heliopolis (July 640); this victory was followed by the siege of Babylon, which after some futile attempts at negotiation was taken on Good Friday, April 6, 641. 'Amr next proceeded in the direction of Alexandria, which was surrendered to him on Nov. 8, 641, on the condition that it should be occupied by the Muslims on Sept. 29 of the following year. The interval was spent by him in founding the city Fostat (Fusṭāṭ), near the modern Cairo, and called after the camp (*Fossatum*) occupied by him while besieging Babylon; and in reducing those coast towns that still offered resistance. The Thebaid seems to have surrendered with scarcely any opposition.

The ease with which this valuable province was wrenched from the Roman empire appears to have been due to the treachery of the governor of Egypt, Cyrus, patriarch of Alexandria, and the incompetence of the Roman generals. The former, called by the Arabs Mukaukis (Muqauqis) from his Coptic name Pkauchios, had for ten years before the arrival of 'Amr maintained a fierce persecution of the Jacobite sect, to which the bulk of the Copts belonged. During the siege of Babylon he had been recalled and exiled, but after the death of Heraclius had been reinstated as patriarch by Heraclonas, and was welcomed back to Alexandria with general rejoicing in Sept. 641. Since Alexandria could neither have been stormed nor starved out by the Arabs, his motives for surrendering it, and with it the whole of Egypt, have been variously interpreted, some supposing him to have been secretly a convert to Islam. The notion that the Arab invaders were welcomed and assisted by the persecuted Copts, conflicts with the fact that the invaders treated both Copts and Romans with the same ruthlessness; but the dissensions which prevailed in the Christian communities certainly weakened resistance to the common enemy. An attempt was made in the year 645 with a force under Manuel, commander of the Imperial forces, to regain Alexandria; the city was surprised, and held till the summer of 646, when it was again stormed by 'Amr. In 654 a fleet was equipped by Constans with a view to an invasion, but it was repulsed, and partly destroyed by storm. From that time no serious effort was made by the Eastern empire to regain possession of the country. The terms on which the Arabs received the submission of Egypt were those on which conquered communities were ordinarily taken under Muslim protection. In return for a tribute of money and food for the troops of occupation, the Christian inhabitants of Egypt were to be excused military service, and to be left free in the observance of their religion and the administration of their affairs.

From 639 to 968 Egypt was a province of the Eastern caliphate, and was ruled by governors sent from the cities which at different times ranked as capitals. Like other provinces of the later Abbasid caliphate its rulers were, during this period, able to establish quasi-independent dynasties, such being those of the Tulunids who ruled from 868 to 905, and the Ikshidis from 935–969. In 969 the country was conquered by Jauhar for the Fatimite caliph Mo'izz, who transferred his capital from Mahdia (*q.v.*) in the Maghrib to Cairo. This dynasty lasted till 1171, when Egypt was again embodied in the Abbasid empire by Saladin, who, however, was himself the founder of a quasi-independent dynasty called the Ayyubites or Ayyubids, which lasted till 1252. The Ayyubites were followed by the Mameluke dynasties, usually classified as Bahri from 1252–1382, and Burji from 1382–1517; these sovereigns were nominally under the suzerainty of Abbasid caliphs, who were in reality instruments of the Mameluke sultans, and resided at Cairo. In 1517 Egypt became part of the Ottoman empire and was governed by pashas sent from Constantinople, whose influence about 1707 gave way to that of officials chosen from the Mamelukes who bore the title Sheik al-balad. After the episode of the French occupat on gove nt by pashas was

restored: Mehemet Ali (appointed pasha in 1805) obtained from the Porte in 1841 the right to bequeath the sovereignty to his descendants, one of whom, Ismail Pasha, received the title Khedive.

Period Under Governors Sent from the Metropolis of the Eastern Caliphate.—The first governor of the newly acquired province was the conqueror 'Amr, whose jurisdiction was presently restricted to Lower Egypt; Upper Egypt being assigned to Abdallāh b. Sa'd, who subsequently obtained Lower Egypt also, 'Amr being recalled, owing to his unwillingness to extort from his subjects as much money as would satisfy the caliph. In the troubles which overtook the Islamic empire with the accession of Othman, Egypt was greatly involved, and it had to be reconquered from the adherents of Ali for Moawiya (Mo'awiyah) by 'Amr, who in A.H. 38 was rewarded for his services by being reinstated as governor, with the right to appropriate the surplus revenue instead of sending it as tribute to the metropolis. In the confusion which followed on the death of the Omayyad caliph Yazīd the Egyptian Muslims declared themselves for Abdallāh b. Zobair, but their leader was defeated in a battle near Ain Shams (Dec 684) by Merwān b. Ḥakam (Merwān I.) who had assumed the caliphate, and the conqueror's son Abd al-'Aziz was appointed governor. They also declared themselves against the usurper Merwan II. in 745, whose lieutenant al-Ḥautharah had to enter Fostat at the head of an army. In 750 Merwān II. himself came to Egypt as a fugitive from the Abbasids, but found that the bulk of the Muslim population had already joined with his enemies, and was defeated and slain in the neighbourhood of Giza in July of the same year. The Abbasid general, Ṣāliḥ b. Ali, who had won the victory, was then appointed governor.

During the period that elapsed between the Muslim conquest and the end of the Omayyad dynasty the nature of the Arab occupation had changed from what had originally been intended, the establishment of garrisons, to systematic colonization. Conversions of Copts to Islam were at first rare, and the old system of taxation was maintained for the greater part of the first Islamic century. The nature of this fiscal system is illustrated by papyri which show that the old division of the country into "districts" (*nomoi*) was maintained To the inhabitants of these districts demands were directly addressed by the governor of Egypt, while the head of the community, ordinarily a Copt, but in some cases a Muslim, was responsible for compliance with the demand. An official called "receiver" (*qabbāl*) was chosen by the inhabitants of each district to take charge of the produce till it was delivered into the public magazines, and received 5% for his trouble. Other evidence shows that the sum for which each district was responsible was distributed over the unit in such a way that artisans and tradesmen paid at a rate similar to that which was enforced on those employed in agriculture. The researches of Wellhausen and Becker have made it clear that the difference which is marked in later Islam between a poll-tax (*jizyah*) and a land-tax (*kharāj*) did not at first exist: the papyri of the 1st century know only of the jizyah, which, however, is not a poll-tax but a land-tax (in the main) The development of the poll-tax imposed on members of tolerated cults seems to be due to various causes, chief of them the acquisition of land by Muslims, who were not at first allowed to possess any, the conversion of Coptic landowners to Islam, and the enforcement (towards the end of the 1st century of Islam) of the poll-tax on monks. The treasury could not afford to lose the land-tax, which it would naturally forfeit by the first two of the above occurrences, and we read of various expedients being tried to prevent this loss. Such were making the Christian community to which the proselyte had belonged pay as much as it had paid when his lands belonged to it, making proselytes pay as before their conversion, or compelling them to abandon their lands on conversion. Eventually the theory spread that all land paid land-tax, whereas members of tolerated sects paid a personal tax also; but during the evolution of this doctrine the relations between conquerors and conquered became more and more strained, and from the time when the control of the finance was separated from the administration of the country (A.D. 715) complaints of extortion became serious

Coptic Revolt.—The resentment of the Copts, who were being excluded from public office, produced a revolt in 725, which was suppressed with difficulty. Two years after, in order that the Arab element in Egypt might be strengthened, a colony of North Arabians (Qaisites) was planted near Bilbeis, reaching the number of 3,000 persons; an event which tended to restore the balance between the two branches of the Arab race, as the first immigrants had belonged almost exclusively to the South Arabian stock. Meanwhile the employment of the Arabic language had been steadily gaining ground, and in 706 it was made the official language of the bureaux, though the occasional use of Greek for this purpose is attested by documents as late as the year 780 Other revolts of the Copts are recorded for the years 739 and 750, the last year of Omayyad domination. The outbreaks in all cases are attributed to increased taxation.

The beginning of the Abbasid period was marked by the erection of a new capital to the north of Fostat, bearing the name *'Askar* or "camp." Apparently at this time the practice of farming the taxes began, which naturally led to even greater extortion than before; and a fresh rising of the Copts is recorded for the fourth year of Abbasid rule. Governors were frequently changed. The three officials of importance whose nomination is mentioned by the historians in addition to that of the governor were the commander of the bodyguard, the minister of finance and the judge. Towards the beginning of the 3rd Islamic century the practice of giving Egypt in fief to a governor was resumed by the caliph Mamūn who bestowed this privilege on 'Abdallāh b. Tāhir, who in 827 was sent to recover Alexandria, which for some ten years had been held by exiles from Spain. 'Abdallāh b. Tāhir decided to reside at Baghdad, sending a deputy to Egypt to govern for him, and this example was afterwards followed. In 828, when Mamūn's brother Motaṣim was feudal lord, a violent insurrection broke out in the Ḥauf, occasioned, as usual, by excessive taxation; it was partly quelled in the next year by Motaṣim, who marched against the rebels with an army of 4,000 Turks. Rebellion broke out repeatedly in the following years, and in 831 the Copts joined with the Arabs against the Government; the state of affairs became so serious that the caliph Mamūn himself visited Egypt, arriving at Fostat in Feb. 832; his general Afshīn fought a decisive battle with the rebels at Bāsharūd in the Ḥauf region, at which the Copts were compelled to surrender, the males were massacred and the women and children sold as slaves.

This event finally crushed the Coptic nation, which never again made head against the Muslims. In the following year the caliph Motaṣim, who surrounded himself with a foreign bodyguard, withdrew the stipends of the Arab soldiers in Egypt; this measure caused some of the Arab tribes who had been long settled in Egypt to revolt, but their resistance was crushed, and the domination of the Arab element in the country from this time gave way to that of foreign mercenaries, who, belonging to one nation or another, held it for most of its subsequent history. Egypt was given in fief to a Turkish general Ashnās (Ashnas), who never visited the country, and the rule of individuals of Turkish origin prevailed till the rise of the Fāṭimites, who for a time interrupted it. The presence of Turks in Egypt is attested by documents as early as 808. While the governor was appointed by the feudal lord, the finance minister continued to be appointed by the caliph. On the death of Ashnās in 844 Egypt was given in fief to another Turkish general Ītākh, but in 850 this person fell out of favour, and the fief was transferred to Montaṣir, son of the caliph Motawakkil. In 856 it was transferred from him to the vizier Fath b Khāqān, who for the first time appointed a Turkish governor. The chief places in the State were also filled with Turks. The period between the rise of the Abbasids and the quasi-independent dynasties of Egypt was marked by much religious persecution, occasioned by the fanaticism of some of the caliphs, the victims being generally Muslim sectarians. (For Egypt under Motawakkil *see* CALIPHATE.)

Tulunid Dynasty.—In 868 Egypt was given in fief to a Turkish general Bayikbeg, who sent thither as his representative his stepson Aḥmad b. Tūlūn, the first founder of a quasi-independent dynasty When in 870 his stepfather died the fief was

[illegible] the lieutenancy [illegible] Ahmad [illegible] enterprise of a usurper in Syria in the year [illegible] caused the caliph to require the presence of Ahmad in that country at the head of an army to quell it; and although this army was not actually employed for the purpose, it was not disbanded by Ahmad, who on his return founded a fresh city called Kaṭā'i', "the fiefs," S.E. of modern Cairo, as quarters for it. On the death of Ahmad's father-in-law in the same year, when Egypt was given in fief to the caliph's brother Mowaffaq (famous for his defeat of the Zanj), Ahmad secured himself in his post by extensive bribery at headquarters; and in the following year the administration of the Syrian frontier was conferred on him as well. By 875 he found himself strong enough to refuse to send tribute to Baghdad, preferring to spend the revenues of Egypt on the maintenance of his army and the erection of great buildings, such as his famous mosque; and though Mowaffaq advanced against him with an army, the project of reducing Ahmad to submission had to be abandoned for want of means. In 877 and 878 Ahmad advanced into Syria and obtained the submission of the chief cities, and at Tarsus entered into friendly relations with the representatives of the Byzantine emperor.

In 882 relations between Ahmad and Mowaffaq again became strained, and the former conceived the bold plan of getting the caliph Mo'tamid into his power, which, however, was frustrated by Mowaffaq's vigilance; but an open rupture was the result, as Mowaffaq formally deprived Ahmad of his lieutenancy, while Ahmad equally formally declared that Mowaffaq had forfeited the succession. A revolt that broke out at Tarsus caused Ahmad to traverse Syria once more in 883, but illness compelled him to return, and on May 10, 884, he died at his residence in Kaṭā'i'. He was the first to establish the claim of Egypt to govern Syria, and from his time Egypt grew more and more independent of the Eastern caliphate. He appears to have invented the fiction which afterwards was repeatedly employed, by which the money spent on mosque-building was supposed to have been furnished by discoveries of buried treasure.

He was succeeded by his son Khomārūya, then 20 years of age, who immediately after his accession had to deal with an attempt on the part of the caliph to recover Syria. By 886 Mowaffaq found it expedient to grant Khomārūya the possession of Egypt, Syria, and the frontier towns for a period of 30 years, and ere long, owing to the disputes of the provincial governors, Khomārūya found it possible to extend his domain to the Euphrates and even the Tigris. On the death of Mowaffaq in 891 the Egyptian governor was able to renew peaceful relations with the caliphs, and receive fresh confirmation in his possessions for 30 years. The security which he thereby gained gave him the opportunity to indulge his taste for costly buildings, parks and other luxuries, of which the chroniclers give accounts bordering on the fabulous. After the marriage of his daughter to the caliph, which was celebrated at enormous expense, an arrangement was made giving the Ṭūlūnid sovereign the viceroyalty of a region extending from Barca on the west to Hit on the east; but tribute, ordinarily to the amount of 300,000 dinars, was to be sent to the metropolis. His realm enjoyed peace till his death in 896, when he fell a victim to some palace intrigue at Damascus.

His young son and successor Abu'l-'Asākir Jaish was murdered after a reign of six months by his troops, who gave his place to his brother Hārūn. In the eight years of his government the Ṭūlūnid empire contracted, owing to the revolts of the deputies which Hārūn was unable to quell, though in 898 he endeavoured to secure a new lease of the sovereignty in Egypt and Syria by a fresh arrangement with the caliph, involving an increase of tribute. The following years witnessed serious troubles in Syria caused by the Carmathians, which called for the intervention of the caliph, who at last succeeded in defeating these fanatics; the officer Mohammed b. Solaimān, to whom the victory was due, was then commissioned by the caliph to reconquer Egypt from the Ṭūlūnids, and after securing the allegiance of the Syrian prefects he invaded Egypt by sea and land at once. Before the arrival of these troops Hārūn had met his death at the hands of an assassin, [illegible] and his un[illegible] Sha'ban who was placed on the [illegible] found himself without the means to collect an adequate army. Fostat was easily taken by Mohammed b. Solaiman at the beginning of 905, and after the infliction of severe punishment on the inhabitants Egypt was once more put under a deputy, 'Isa al-Naushari, appointed directly by the caliph.

In the middle of the year 914 Egypt was invaded for the first time by a Fāṭimite force sent by the caliph al-Mahdī 'Obaidallah now established at Kairawān. The Mahdi's son succeeded in taking Alexandria, and advancing as far as the Fayūm; but once more the Abbasid caliph sent a powerful army to assist his viceroy, and the invaders were driven out of the country, though the Fāṭimite caliph continued to maintain active propaganda in Egypt. In 919 Alexandria was again seized by the Mahdi's son, afterwards the caliph al-Qā'im, and while his forces advanced northward as far as Ushmunain (Eshmunain) he was reinforced by a fleet which arrived at Alexandria. This fleet was destroyed by a far smaller one sent by the Baghdad caliph to Rosetta; but Egypt was not freed from the invaders till the year 921, after reinforcements had been repeatedly sent from Baghdad to deal with them. The extortions necessitated by these wars and the incompetence of the viceroys brought Egypt into a miserable condition: and the numerous political crises at Baghdad prevented for a time any serious measures being taken to improve it. After a struggle between various pretenders to the viceroyalty, Mohammed b. Ṭughj, son of a Ṭūlūnid prefect of Damascus, was sent by the caliph to restore order; he had to force his entrance into the country by an engagement with one of the pretenders, Ibn Kaighlagh, in which he was victorious, and entered Fostat in Aug. 935.

Ikshidite Dynasty.—Mohammed b. Ṭughj was the founder of the Ikshīdī dynasty, so called from the title Ikshīd, conferred on him at his request by the caliph shortly after his appointment to the governorship of Egypt; it is said to have had the sense of "king" in Ferghana, whence this person's ancestors had come to enter the service of the caliph Moraṣim. He had himself served in various capacities under the governor of Egypt, Takīn, whose son he displaced, and had afterwards held various governorships in Syria. He united in his person the offices of governor and minister of finance, which had been separate since the time of the Ṭūlūnids. He endeavoured to replenish the treasury not only by extreme economy, but by inflicting fines on a vast scale on persons who had held offices under his predecessor and others who had rendered themselves suspect. The disaffected in Egypt kept up communications with the Fāṭimites, against whom the Ikshīd collected a vast army, which, however, had first to be employed in resisting an invasion of Egypt threatened by Ibn Rāiq, an adventurer who had seized Syria; after an indecisive engagement at Lajūn the Ikshīd decided to make peace with Ibn Rāiq, undertaking to pay him tribute. In 941, after the latter's death, the Ikshīd took the opportunity of invading Syria, which the caliph permitted him to hold with the addition of the sacred cities of Mecca and Medina, which the Ṭūlūnids had aspired to possess.

In the year 944 he was summoned to Mesopotamia to assist the caliph, who had been driven from Baghdad; and he proposed, though unsuccessfully, to take the caliph with him to Egypt. At this time he obtained hereditary rights for his family in the government of that country and Syria. The Ḥamdānid Saif addaula shortly after this assumed the governorship of Aleppo, and became involved in a struggle with the Ikshīd, whose general, Kāfūr, he defeated in an engagement between Homs and Hamah (Hamath). In a later battle he was himself defeated by the Ikshīd, when an arrangement was made permitting Saif addaula to retain most of Syria, while a prefect appointed by the Ikshīd was to remain in Damascus. The Buyid ruler, who was now supreme at Baghdad, permitted the Ikshīd to remain in possession of his viceroyalty, but shortly after receiving this confirmation he died at Damascus in 946.

The second of this dynasty was the Ikshīd's son Ūnjūr, who had been proclaimed in his father's time, and began his government under the tutelage of the negro Kāfūr. Syria was immediately overrun by Saif addaula, but he was defeated by Kāfūr in two engagements, and was compelled to recognize the overlord-

ship of the Egyptian viceroy. At the death of Ūnjūr in 961 his brother Abu'l-Ḥasan 'Alī was made viceroy with the caliph's consent by Kāfūr, who continued to govern for his chief as before. The land was during this period threatened at once by the Fāṭimites from the west; the Nubians from the south, and the Carmathians from the east; when the second Ikshīdī died, Kāfūr at first made a pretence of appointing his young son Aḥmad as his successor, but deemed it safer to assume the viceroyalty himself, setting an example which in Mameluke times was often followed. He occupied the post little more than three years, and on his death in 968 the aforementioned Aḥmad, called Abu'l-Fawāris, was appointed successor, under the tutelage of a vizier named Ibn Furāt, who had long served under the Ikshīdīs. The accession of this prince was followed by an incursion of the Carmathians into Syria, before whom the Ikshīdī governor fled into Egypt, where he had for a time to undertake the management of affairs, and arrested Ibn Furāt, who had proved himself incompetent.

The administration of Ibn Furāt was fatal to the Ikshīdīs and momentous for Egypt, since a Jewish convert, Jacob, son of Killis, who had been in the Ikshīd's service, and was ill-treated by Ibn Furāt, fled to the Fāṭimite sovereign, and persuaded him that the time for invading Egypt with a prospect of success had arrived, since there was no one in Fostat capable of organizing a plan of defence, and the dissensions between the Buyids at Baghdad rendered it improbable that any succour would arrive from that quarter. The Fāṭimite caliph Mo'izz li-dīn allāh was also in correspondence with other residents in Egypt, where the Alid party from the beginning of Abbasid times had always had many supporters; and the danger from the Carmathians rendered the presence of a strong Government necessary. The Fāṭimite general Jauhar, who enjoyed the complete confidence of the Fāṭimite sovereign, started from Rakkāda at the beginning of March 969 with the view of seizing Egypt.

Before his arrival the administration of affairs had again been committed to Ibn Furāt, who, on hearing of the threatened invasion, at first proposed to treat with Jauhar for the peaceful surrender of the country; but the majority of the troops at Fostat preferred to make some resistance, and an advance was made to meet Jauhar in the neighbourhood of Giza. He had little difficulty in defeating the Egyptian army, and on July 6, 969, entered Fostat at the head of his forces. The name of Mo'izz was immediately introduced into public prayer, and coins were struck in his name. The Ikshīdī governor of Damascus, a cousin of Abu'l-Fawāris Aḥmad, endeavoured to save Syria, but was defeated at Ramleh by a general sent by Jauhar and taken prisoner. Thus the Ikshīdī dynasty came to an end, and Egypt was transferred from the Eastern to the Western caliphate, of which it furnished the metropolis.

The Fatimite Period begins with the taking of Fostat by Jauhar, who immediately began the building of a new city, al-Kāhira or Cairo, to furnish quarters for his army. A palace for the caliph and a mosque for the army were immediately constructed, the latter still famous as al-Azhar, and for many centuries the centre of Muslim learning. Almost immediately after the conquest of Egypt, Jauhar found himself engaged in a struggle with the Carmathians (*q.v.*), and the Carmathian leader al-Ḥasan b. Aḥmad al-A'ṣam received aid from Baghdad for the purpose of recovering Syria to the Abbasids. The Fāṭimite general Ja'far, hoping to deal with this enemy independently of Jauhar, met the Carmathians without waiting for reinforcements from Egypt, and was defeated and killed. Damascus, which he had previously occupied, was taken by the Carmathians, and the name of the Abbasid caliph substituted for that of Mo'izz in public worship. Hasan al-A'ṣam advanced from Damascus through Palestine to Egypt, encountering little resistance on the way; and in the autumn of 971 Jauhar found himself besieged in his new city. By a timely sortie, preceded by the administration of bribes to various officers in the Carmathian host, Jauhar succeeded in inflicting a severe defeat on the besiegers, who were compelled to evacuate Egypt and part of Syria.

Meanwhile Mo'izz had been summoned to enter the palace that had been prepared for him, and after leaving a viceroy to take charge of his western possessions he arrived in Alexandria on May 31, 973, and proceeded to instruct his new subjects in the particular form of religion (Shī'ism) which his family represented. As this was in origin identical with that professed by the Carmathians, he hoped to gain the submission of their leader by argument; but this plan was unsuccessful, and there was a fresh invasion from that quarter in the year after his arrival, and the caliph found himself besieged in his capital. The Carmathians were gradually forced to retreat from Egypt and from Syria and Mo'izz was able to take the offensive against the Byzantines with whom his generals fought in Syria with varying fortune Before his death he was acknowledged as caliph in Mecca and Medina, as well as Syria, Egypt and North Africa as far as Tangier.

In the reign of the second Egyptian Fāṭimite 'Azīz billah, Jauhar, who appears to have been cashiered by Mo'izz, was again employed at the instance of Jacob b. Killis, who had been raised to the rank of vizier, to deal with the situation in Syria, where a Turkish general Aftakīn had gained possession of Damascus, and was raiding the whole country; on the arrival of Jauhar in Syria the Turks called the Carmathians to their aid, and after a campaign of many vicissitudes Jauhar had to return to Egypt to implore the caliph himself to take the field. In Aug. 977 'Azīz met the united forces of Aftakīn and his Carmathian ally outside Ramleh in Palestine and inflicted a crushing defeat on them, which was followed by the capture of Aftakīn; this able officer was taken to Egypt, and honourably treated by the caliph, thereby incurring the jealousy of Jacob b. Killis, who caused him, it is said, to be poisoned. This vizier had the astuteness to see the necessity of codifying the doctrines of the Fāṭimites, and himself undertook this task; in the newly-established mosque of el-Azhar he got his master to make provision for a perpetual series of teachers and students of his manual. It would appear, however, that a large amount of toleration was conceded by the first two Egyptian Fāṭimites to the other sects of Islam, and to other communities. Indeed at one time in 'Azīz's reign the vizierate of Egypt was held by a Christian, Jesus, son of Nestorius, who appointed as his deputy in Syria a Jew, Manasseh b. Abraham. These persons were charged by the Muslims with unduly favouring their co-religionists, and the belief that the Christians of Egypt were in league with the Byzantine emperor, and even burned a fleet which was being built for the Byzantine war, led to some persecution. 'Azīz attempted without success to enter into friendly relations with the Buyid ruler of Baghdad, 'Aḍod addaula. He then tried to gain possession of Aleppo, as the key to 'Irāk, but this was prevented by the intervention of the Byzantines. His North African possessions were maintained and extended by 'Alī, son of Bulukkīn, whom Mo'izz had left as his deputy; but the recognition of the Fāṭimite caliph in this region was little more than nominal.

His successor *'Abū 'Alī al-Manṣūr*, who reigned under the title *al-Ḥākim bi'amr allāh*, came to the throne at the age of 11, being the son of 'Azīz by a Christian mother. He was at first under the tutelage of the Slav Burjuwān, whose policy it was to favour the Turkish element in the army as against the Maghribine, on which the strength of the Fāṭimites had till then rested; his conduct of affairs was vigourous and successful, and he concluded a peace with the Greek emperor. After a few years' regency he was assassinated at the instance of the young sovereign, who at an early age developed a dislike for control and jealousy of his rights as caliph. He is branded by historians as the Caligula of the East, who took a delight in oppression and persecution. He is perhaps best remembered by his destruction of the church of the Holy Sepulchre at Jerusalem (1010), a measure which helped to provoke the Crusades, but was only part of a general scheme for converting all Christians and Jews in his dominions to his own opinions by force. A more reputable expedient with the same end in view was the construction of a great library in Cairo, with ample provision for students; this was modelled on a similar institution at Baghdad. It formed part of the great palace of the Fāṭimites, and was intended to be the centre of their propaganda. At times, however, he ordered the destruction of all Christian churches in Egypt, and the banishment of all who did not adopt

... con ..ued to employ Chr ... ans ... h or ... s ... per ... or was r ... a ... re ... e ... r ... he ... re ... he ... hought ... o ... am cavalry: the violent opposition which this aroused among [th]e Muslims probably led him to adopt milder measures towards [hi]s other subjects, and those who had been forcibly converted [w]ere permitted to return to their former religion and rebuild [th]eir places of worship. Whether his disappearance at the begin[ni]ng of the year 1021 was due to the resentment of his outraged [su]bjects, or, as the historians say, to his sister's fear that he would [bequ]eath the caliphate to a distant relative to the exclusion of his [ow]n son, will never be known. In spite of his caprices he appears [t]o have shown competence in the management of external affairs; [en]terprises of pretenders both in Egypt and Syria were crushed [w]ith promptitude; and his name was at times mentioned in public [w]orship in Aleppo and Mosul.

His son *Abu'l-Hasan 'Ali*, who succeeded him with the title [a]*l-Zāhir li'i'zāz dīn Allāh*, was 16 years of age at the time, and [f]or four years his aunt Sitt al-Mulk acted as regent; she appears [t]o have been an astute but utterly unscrupulous woman. After [h]er death the caliph was in the power of various ministers, under [w]hose management of affairs Syria was for a time lost to the [E]gyptian caliphate, and Egypt itself raided by the Syrian usurpers, [o]f whom one, Ṣāliḥ b. Mirdās, succeeded in establishing a dynasty [a]t Aleppo, which maintained itself after Syria and Palestine had [b]een recovered for the Fāṭimites by Anushtakīn al-Dizbarī at [t]he battle of Ukhuwānah in 1029. His successor, *Abū Tamīm Ma'add*, who reigned with the title *al-Mostanṣir*, was also an in[f]ant at the time of his accession, being little more than seven [y]ears of age. The power was largely in the hands of his mother, [a] negress, who promoted the interests of her kinsmen at court, [w]here indeed even in Ḥākim's time they had been used as a [c]ounterpoise to the Maghribine and Turkish elements in the army. [I]n the first years of this reign affairs were administered by the [v]izier al-Jarjarā'ī, by whose mismanagement Aleppo was lost to [t]he Fāṭimites. At his death in 1044 the chief influence passed into [t]he hands of Abu Sa'd, a Jew, and the former master of the [q]ueen-mother, and at the end of four years he was assassinated at [t]he instance of another Jew (Ṣadakah, perhaps Zedekiah, b. [J]oseph al-Falāḥī), whom he had appointed vizier. In this reign Mo'izz b. Badis, the 4th ruler of the dependent Zeirid dynasty which had ruled in the Maghrib since the migration of the Fāṭimite Mo'izz to Egypt, definitely abjured his allegiance (1049) and returned to Sunnite principles and subjection to the Baghdad caliphate. The Zeirids maintained Mahdia (*see* ALGIERS), while other cities of the Maghrib were colonized by Arab tribes sent thither by the Cairene vizier. This loss was more than compensated by the enrolment of Yemen among the countries which recognized the Fāṭimite caliphate through the enterprise of one 'Ali b. Mohammed al-Ṣulaiḥī, while owing to the disputes between the Turkish generals who claimed supremacy at Baghdad, Mostanṣir's name was mentioned in public prayer at that metropolis on Jan. 12, 1058, when a Turkish adventurer Basāsīrī was for a time in power. The Egyptian court, chiefly owing to the jealousy of the vizier, sent no efficient aid to Basāsīrī, and after a year Baghdad was retaken by the Seljūk Toghrul Beg, and the Abbasid caliph restored to his rights. In the following years the troubles in Egypt caused by the struggles between the Turkish and negro elements in Mostanṣir's army nearly brought the country into the dominion of the Abbasids. After several battles of various issue the Turkish commander Nāṣir addaula b. Hamdān occupied Cairo, and at the end of 1068 plundered the caliph's palace; the valuable library which had been begun by Ḥākim was pillaged, and an accidental fire caused great destruction. The caliph and his family were reduced to destitution, and Nāṣir addaula began negotiations for restoring the name of the Abbasid caliph in public prayer; he was, however, assassinated before he could carry this out, and his assassin, also a Turk, appointed vizier. Mostanṣir then summoned to his aid Badr al-Jamālī, an Armenian who had displayed competence in various posts which he had held in Syria. Early in 1074 he arrived in Cairo accompanied by a bodyguard of Armenians; he contrived to massacre the chiefs of the party at the time in po[ss]ession of power and was g[iv]en by Mostan[ṣi]r com[pl]ete control of affairs. The period of internal disturbances, which had been accompanied by famine and pestilence, had caused usurpers to spring up in all parts of Egypt, and Badr was compelled practically to reconquer the country. During this time, however, Syria was overrun by an invader in league with the Seljūk Malik Shah, and Damascus was permanently lost to the Fāṭimites; other cities were recovered by Badr himself or his officers. The time of Mostanṣir is otherwise memorable for the rise of the Assassins (*q.v.*), who at the first supported the claims of his eldest son Nizār to the succession against the youngest Aḥmed, who was favoured by the family of Badr. When Badr died in 1094 his influence was inherited by his son, al-Afḍal Shāhinshāh, and this, at the death of Mostanṣir in the same year, was thrown in favour of *Aḥmed*, who succeeded to the caliphate with the title *al-Mosta'lī billāh*.

The Crusades.—The beginning of his reign coincided with the beginning of the crusades. Jerusalem had recently been recovered from the Turks by al-Afḍal, and its garrison was unable to make a prolonged resistance to the Frankish attack (1099). Al-Afḍal himself was defeated near Ascalon, and the Franks obtained much of the Fāṭimite territory in Palestine. After a reign of seven years Mosta'lī died and the caliphate was given by al-Afḍal to an infant son, aged five years at the time, who was placed on the throne with the title *al-Āmir biahkām allāh*, and for 20 years was under the tutelage of al-Afḍal. He made repeated attempts to recover the Syrian and Palestinian cities from the Franks, but with poor success. In 1118 Egypt was invaded by Baldwin I., who burned the gates and the mosques of Farama, and advanced to Tinnis, whence illness compelled him to retreat. In Aug. 1121, possibly with the connivance of the caliph, al-Afḍal was assassinated and his offices were given to one of the caliph's creatures, Mohammed b. Fātik al-Batā'iḥī, who took the title *al-Ma'mūn*. His external policy was not more fortunate than that of his predecessor, as he lost Tyre to the Franks, and a fleet equipped by him was defeated by the Venetians. On Oct. 4, 1125, he with his followers was seized and imprisoned by order of the caliph Āmir, who was now resolved to govern by himself, with the assistance of only subordinate officials, of whom two were drawn from the Samaritan and Christian communities. The vizier was afterwards crucified with his five brothers. The caliph's personal government appears to have been incompetent, and to have been marked by extortions and other arbitrary measures. He was assassinated in Oct. 1129 by some members of the sect who believed in the claims of Nizār, son of Mostanṣir.

The succeeding caliph, *Abu'l-Maimūn 'Abd al-Majīd*, who took the title *al-Ḥāfiẓ lidīn allāh*, was his predecessor's cousin and of ripe age. His reign was disturbed by the factions of the soldiery, and for a time he became subject to his own son Ḥasan. Before his death in 1149 he had recovered his authority. His son *Abu'l-Manṣūr Ismā'īl*, who was 17 years old, succeeded him with the title *al-Ẓāfir bia'dā allāh*. From this reign to the end of the Fāṭimite period we have the journals of two eminent men, Usāmah b. Munqidh and Umārah of Yemen, which throw light on the leading characters. The civil dissensions of Egypt were notorious at the time. The new reign began by an armed struggle between two commanders for the post of vizier, which in Jan. 1150 was decided in favour of the Amir Ibn Sallār. This vizier was presently assassinated by the direction of his stepson 'Abbās, who was raised to the vizierate in his place. This event was shortly followed by the loss to the Fāṭimites of Ascalon, the last place in Syria which they held; its loss was attributed to dissensions between the parties of which the garrison consisted. Four years later (April 1154) the caliph was murdered by his vizier 'Abbās, according to Usāmah, because the caliph had suggested to his favourite, the vizier's son, to murder his father; and this was followed by a massacre of the brothers of Ẓāfir, followed by the raising of his infant son *Abu'l-Qāsim 'Īsā* to the throne.

The new caliph, who was not five years old, received the title *al-Fā'iz binaṣr allāh*, and was at first in the power of 'Abbās. The women of the palace, however, summoned to their aid Ṭalā'i' b. Ruzzīk, prefect of Ushmunain, at whose arrival in Cairo the

troops deserted 'Abbās, who was compelled to flee into Syria, taking his son and Usāmah with him. 'Abbās was killed by the Franks near Ascalon, his son sent in a cage to Cairo where he was executed, while Usāmah escaped to Damascus.

The infant Fā'iz, who had been permanently incapacitated by the scenes of violence which accompanied his accession, died in 1160. Ṭalā'i' chose to succeed him a grandson of Zāfir, who was nine years of age, and received the title *al-ʿāḍid lidīn allāh*. Ṭala'i', who had complete control of affairs, introduced the practice of farming the taxes for periods of six months instead of a year, which led to great misery, as the taxes were demanded twice. His death was brought on by the rigour with which he treated the princesses, one of whom, with or without the connivance of the caliph, organized a plot for his assassination, and he died in Sept. 1160. His son Ruzzīk inherited his post and maintained himself in it for more than a year, when another prefect of Upper Egypt, Shāwar b. Mujīr, brought a force to Cairo, before which Ruzzīk fled, to be shortly afterwards captured and beheaded. Shāwar's entry into Cairo was at the beginning of 1163; after nine months he was compelled to flee before another adventurer, an officer in the army named Ḍirghām. Shāwar's flight was directed to Damascus, where he was favourably received by the prince Nureddin, who sent with him to Cairo a force of Kurds under Asad al-dīn Shīrgūh. At the same time Egypt was invaded by the Franks, who raided and did much damage on the coast. Ḍurghām was defeated and killed, but a dispute then arose between Shāwar and his Syrian allies for the possession of Egypt. Shāwar, being unable to cope with the Syrians, demanded help of the Frankish king of Jerusalem Amalric (Amauri) I., who hastened to his aid with a large force, which united with Shāwar's and besieged Shīrgūh in Bilbeis for three months; at the end of this time, owing to the successes of Nureddin in Syria, the Franks granted Shīrgūh a free passage with his troops back to Syria, on condition of Egypt being evacuated (Oct. 1164). Rather more than two years later Shīrgūh persuaded Nureddin to put him at the head of another expedition to Egypt, which left Syria in Jan. 1167, and, entering Egypt by the land route, crossed the Nile at Itfīḥ (Atfih), and encamped at Gīza; a Frankish army hastened to Shāwar's aid. At the battle of Bābain (April 11, 1167) the allies were defeated by the forces commanded by Shīrgūh and his nephew Saladin, who was presently made prefect of Alexandria, which surrendered to Shīrgūh without a struggle. Saladin was soon besieged by the allies in Alexandria; but after 75 days the siege was raised, Shīrgūh having made a threatening movement on Cairo, where a Frankish garrison had been admitted by Shāwar. Terms were then made by which both Syrians and Franks were to quit Egypt, though the garrison of Cairo remained; the hostile attitude of the Muslim population to this garrison led to another invasion at the beginning of 1168 by King Amalric, who after taking Bilbeis advanced to Cairo. The caliph, who up to this time appears to have left the administration to the viziers, now sent for Shīrgūh, whose speedy arrival in Egypt caused the Franks to withdraw. Reaching Cairo on Jan. 6, 1169, he was soon able to get possession of Shāwar's person, and after the prefect's execution, some ten days later, he was appointed vizier by the caliph. After two months Shīrgūh died of indigestion (March 23, 1169), and the caliph appointed Saladin as successor to Shīrgūh; the new vizier professed to hold office as a deputy of Nureddin, whose name was mentioned in public worship after that of the caliph. Nureddin loyally aided his deputy in dealing with Frankish invasions of Egypt, but the anomaly by which he, being a Sunnite, was made in Egypt to recognize a Fāṭimite caliph could not long continue. On Sept. 17, 1171, the name of the Abbasid caliph was substituted for that of 'Āḍid in public worship. The latter's death occurred almost at the same moment, and it is uncertain whether he ever heard of his deposition. The last of the Fāṭimite caliphs was not quite 21 years old at his death.

Ayyūbite Period.—Saladin by the advice of his chief Nureddin cashiered the Fāṭimite judges and encouraged the study of orthodox theology and jurisprudence in Egypt by the foundation of colleges and chairs. On the death of the ex-caliph he was confirmed in the prefecture of Egypt as deputy of Nureddin; and on the decease of the latter in 1174 (April 12) he took the title sultan, so that with this year the Ayyūbite period of Egyptian history properly begins. During the whole of it Damascus rather than Cairo counted as the metropolis of the empire. The Egyptian army, which was motley in character, was disbanded by the new sultan, whose troops were Kurds. Though he did not build a new metropolis he fortified Cairo with the addition of a citadel and from this time till the French occupation of Egypt the citadel of Cairo was the political centre of the country. It was in 1183 that Saladin's rule over Egypt and North Syria was consolidated. His famous wars with the Franks belong to the history of the crusades and to his personal biography (*q.v.*).

Saladin at his death divided his dominions between his sons, of whom 'Othman succeeded to Egypt with the title *Malik al-Azīz 'Imād al-dīn*. The division was not satisfactory to the heirs, and after three years (beginning of 1196) the Egyptian sultan conspired with his uncle Malik al-'Ādil to deprive Saladin's son al-Afḍal of Damascus, which had fallen to his lot. The war between the brothers was continued with intervals of peace, during which al-'Ādil repeatedly changed sides: eventually he with al-'Azīz besieged and took Damascus, and sent al-Afḍal to Sarkhad, while al-'Ādil remained in possession of Damascus. On the death of al-'Azīz on Nov. 29, 1198, in consequence of a hunting accident, his infant son Mohammed was raised to the throne with the title *Malik al-Manṣūr Nāṣir al-dīn*, and his uncle al-Afḍal sent for from Sarkhad to take the post of regent. So soon as al-Afḍal had got possession of his nephew's person, he started on an expedition for the recovery of Damascus: al-'Ādil not only frustrated this, but drove him back to Egypt, where on Jan. 25, 1200, a battle was fought between the armies of the two at Bilbeis, resulting in the defeat of al-Afḍal, who was sent back to Sarkhad, while al-'Ādil assumed the regency, for which after a few months he substituted the sovereignty, causing his nephew to be deposed. He reigned under the title *Malik al-'Ādil Saif al-dīn*. His name was Abū Bakr.

Though the early years of his reign were marked by numerous disasters, famine, pestilence and earthquake, of which the second seems to have been exceedingly serious, he reunited under his sway the whole of the empire which had belonged to his brother, his generals conquered parts of Mesopotamia and Armenia, and in 1215 he got possession of Yemen. He followed the plan of dividing his empire between his sons, the eldest Mohammed, called *Malik al-Kāmil*, being his viceroy in Egypt, while al-Mu'azzam 'Īsā governed Syria, al-Ashraf Mūsā his eastern and al-Malik al-Auḥad Ayyūb his northern possessions. His death occurred at Alikin (1218), a village near Damascus, while the Franks were besieging Damietta, which was defended by al-Kāmil, to whom his father kept sending reinforcements. Damietta was taken by the Franks on Nov. 6, 1219; al-Kāmil thereupon proclaimed the Jihād, and was joined at his fortified camp, afterwards the site of Manṣūra, by troops from various parts of Egypt, Syria and Mesopotamia, including the forces of his brothers 'Īsā and Mūsā. With these allies, and availing himself of the advantages offered by the inundation of the Nile, al-Kāmil was able to cut off both the advance and the retreat of the invaders, and on Aug. 31, 1221, a peace was concluded, by which the Franks evacuated Egypt.

For some years the dominions of al-'Ādil remained divided between his sons: when the affairs of Egypt were settled, al-Kāmil determined to reunite them as before. Various cities in Palestine and Syria were yielded to Frederick II. as the price of his help against the son of Mu'azzam 'Īsā, who reigned at Damascus with the title of Malik al-Nāṣir. About 1231–32 Kāmil led a confederacy of Ayyūbite princes against the Seljuk Kaikobad into Asia Minor, but his allies mistrusted him and victory rested with Kaikobad (*see* SELJUKS). Before Kāmil's death he was mentioned in public prayer at Mecca as lord of Mecca (Hejāz), Yemen, Zabīd, Upper and Lower Egypt, Syria and Mesopotamia.

At his death (May 8, 1238) at Damascus, his son Abū Bakr was appointed to succeed with the title *Malik al-'Ādil Saif al-dīn*; but his elder brother Malik al-Ṣāliḥ Najm al-dīn Ayyūb after various adventures [illegible] him and entered Cairo as sultan

in June 1240. His administration is highly praised by Ibn Khallikān who lived under it. He made large purchases of slaves (Mamelukes) for his army, and when the inhabitants of Cairo complained of their lawlessness, he built barracks for them on the island of Roda (Rauḍa), whence they were called Baḥrī or Nile Mamelukes, which became the name of the first dynasty that originated from them. Much of his time was spent in campaigns in Syria: eventually he succeeded in recovering most of the Syrian cities. Jerusalem was occupied in 1244. His name is commemorated by the town of Sālihia, which he built in the year 1246 as a resting-place for his armies on their marches through the desert from Egypt to Palestine. In 1249 he was recalled from the siege of Homs by the news of the invasion of Egypt by Louis IX., and in spite of illness he hastened to Ushmum Tannā, in the neighbourhood of Damietta which he provisioned for a siege. Damietta was taken on June 6, 1249, owing to the treachery of its commanders: 54 chieftains were afterwards executed for this by the sultan. On Nov. 22 the sultan died at Manṣūra, but his death was carefully concealed by the amirs Lājīn and Aktai, acting in concert with the Queen Shajar al-durr, till the arrival from Syria of the heir to the throne, *Tūrānshāh*, who was proclaimed some four months later. At the battle of Fāriskūr, April 6, 1250, the invaders were utterly routed and the French king fell into the hands of the Egyptian sultan. The sultan who himself had had no share in the victory, advanced after it from Mansūra to Fāriskūr, where his conduct became menacing to the amirs who had raised him to the throne, and to Shajar al-durr by whom he was overthrown.

Period of Baḥrī Mamelukes.—The dynasties that succeeded the Ayyūbites till the conquest of Egypt by the Ottomans bore the title Dynasties of the Turks, but are more often called Mameluke dynasties, because the sultans were drawn from the enfranchised slaves who constituted the court, and officered the army. The family of the fourth of these sovereigns, Ka'ā'ūn (Qalā'ūn), reigned for 110 years, but otherwise no sultan was able to found a durable dynasty: after the death of a sultan he was usually succeeded by an infant son, who after a short time was dethroned by a new usurper.

After the death of the Sultan Tūrānshāh, his step-mother at first was raised to the vacant throne, but the rule of a queen caused scandal to the Muslim world, and Shajar al-durr gave way to this sentiment by marrying Aibek, the captain of the retainers, and allowing the title sultan to be conferred on him. For policy's sake, however, Aibek nominally associated with himself on the throne a scion of the Ayyūbite house, Malik al-Ashraf Musa, who died in prison (1252 or 1254). Aibek meanwhile immediately became involved in war with the Ayyūbite Malik al-Nāṣir, who was in possession of Syria, with whom the caliph induced him after some indecisive actions to make peace: he then successfully quelled a mutiny of Mamelukes, whom he compelled to take refuge with the last Abbasid caliph Mostasim in Baghdad and elsewhere. On April 10, 1257, Aibek was murdered by his wife Shajar al-durr, who was indignant at his asking for the hand of another queen: but Aibek's followers immediately avenged his death, placing on the throne his infant son *Malik al-Manṣūr*, who, however, was almost immediately displaced by his guardian *Koṭuz*, on the plea that the Mongol danger necessitated the presence of a grown man at the head of affairs. In 1260 the Syrian kingdom of al-Nāṣir was destroyed by Hulaku (Hulagu), the great Mongol chief, founder of the Ilkhan Dynasty (*see* MONGOLS), who, having finally overthrown the caliph of Baghdad (*see* CALIPHATE), also despatched a threatening letter to Koṭuz; but later in the same year Syria was invaded by Koṭuz, who defeated Hulagu's lieutenant at the battle of 'Ain Jālūt (Sept. 3, 1260), in consequence of which event the Syrian cities all rose against the Mongols, and the Egyptian sultan became master of the country with the exception of such places as were still held by the crusaders.

Before Koṭuz had reigned a year he was murdered at Sālihia by his lieutenant Bibers (Oct. 23, 1260), who assumed the sovereignty with the title of *Malik al-Ẓāhir* presently altered to al-Ẓāhir. He had originally been a slave of Malik al-Ṣaliḥ, had distinguished himself at the battle after which Louis IX. was captured, and had helped to murder Tūrānshāh. Sultan Bibars who proved to be one of the most competent of the Baḥrī Mamelukes, made Egypt the centre of the Muslim world by re-establishing in theory the Abbasid caliphate, which had lapsed through the taking of Baghdad by Hulagu, followed by the execution of the caliph. Bibars recognized the claim of a certain Abu'l-Qāsim Aḥmed to be the son of Ẓāhir, the 35th Abbasid caliph, and installed him as Commander of the Faithful at Cairo with the title *al-Mostanṣir billāh*. Mostanṣir then proceeded to confer on Bibars the title sultan, and to address to him a homily, explaining his duties. The sultan appears to have contemplated restoring the new caliph to the throne of Baghdad; but the force which he sent with him for this purpose was quite insufficient, and Mostanṣir was defeated and slain. This did not prevent Bibars from maintaining his policy of appointing an Abbasid for the purpose of conferring legitimacy on himself; but he encouraged no further attempts at re-establishing the Abbasids at Baghdad, and his principle, adopted by successive sultans, was that the caliph should not leave Cairo except when accompanying the sultan on an expedition.

The reign of Bibars was spent largely in successful wars against the crusaders, the Armenians and the Seljukids of Asia Minor. He further reduced the Ismā'īlians or Assassins, whose existence as a community lasted on in Syria after it had nearly come to an end in Persia. He made Nubia tributary, therein extending Muslim arms farther south than any previous sultan had brought them. His authority was before his death recognized all over Syria (with the exception of the few cities still in the power of the Franks), over Arabia, with the exception of Yemen, on the Euphrates from Birah to Kerkesia (Circesium) on the Chaboras (Khabur), whilst the amirs of north-western Africa were tributary to him. He was the first sultan who acknowledged the equal authority of the four schools of law, and appointed judges belonging to each in Egypt and Syria; he was thus able to get his measures approved by one school when condemned by another.

On July 1, 1277, Bibars died. His son Malik al-Sa'īd was soon superseded by his father-in-law, *Kalā'ūn*, a Mameluke who had risen high in the former sovereign's service. Kalā'ūn, without pursuing any career of active conquest, successfully defended Syria from a Mongol invasion which he defeated in 1281 at the battle of Homs (Emesa). He did much to consolidate his dominions, and especially to extend Egyptian commerce, for which purpose he started passports enabling merchants to travel with safety through Egypt and Syria as far as India. He directed his energies towards capturing the last places that remained in the hands of the Franks, and proceeded to take Markab, Latakia and Tripoli (April 26, 1289). In 1290 he planned an attack on Acre, but died (Nov. 10) in the middle of his preparations. Under him we first hear of the Burjite Mamelukes, who owe their name to the citadel (Burj) of Cairo, where 3,700 of the whole number of 12,000 Mamelukes maintained by this sovereign were quartered. He also set an example, frequently followed, of the practice of dismissing all non-Muslims from Government posts: this was often done by his successors with the view of conciliating the Muslims, but it was speedily found that the services of the Jewish and Christian clerks were again required. He further founded a hospital for clinical research on a scale formerly unknown.

Kalā'ūn was followed by his son *Khalīl* (*Malik al-Ashraf Ṣalāḥ al-dīn*), who carried out his father's policy of driving the Franks out of Syria and Palestine, and proceeded with the siege of Acre, which he took (May 18, 1291) after a siege of 43 days. The capture and destruction of this important place were followed by the capture of Tyre, Sidon, Haifa, Athlit and Beirut, and thus Syria was cleared of the crusaders. He also planned an expedition against the prince of Lesser Armenia, which was averted by the surrender of Behesna, Marash and Tell Ḥamdūn. The disputes between his favourite, the vizier Ibn al-Sa'lūs, and his viceroy Baidara, led to his being murdered by the latter (Dec. 12, 1293), who was proclaimed sultan, but almost immediately fell a victim to the vengeance of the deceased sultan's party who placed a son of Kala'un, *Mohammed Malik al-Nasir* on the throne.

Malik al-Nasir This prince had the fortune of reigning three times being twice dethroned he was first installed on

Dec. 14, 1293, when he was nine years old, and the affairs of the kingdom were undertaken by a cabinet, consisting of a vizier (ʿAlam al-dīn Sinjar), a viceroy (Kitboga), a war minister (Ḥusām al-dīn Lājīn al-Rūmī), a prefect of the palace (Rokneddin Bibars Jāshengir) and a secretary of State (Rokneddin Bibars Manṣūrī). This cabinet naturally split into rival camps, in consequence of which Kitboga, himself a Mongol, with the aid of other Mongols who had come into Egypt after the battle of Homs, succeeded in ousting his rivals, and presently, with the aid of the surviving assassins of the former sultan, compelling Malik al-Nāṣir to abdicate in his favour (Dec. 1, 1294). The usurper was, however, able to maintain himself for two years only, and in 1296 one of the murderers of Khalil, Ḥusām al-dīn *Lajīn*, son-in-law of the sultan Bibars and formerly governor of Damascus, was installed in his place (Nov. 26, 1296). It had become the practice of the Egyptian sultans to bestow all offices of importance on their own freedmen (Mamelukes) to the exclusion of the older amirs, whom they could not trust so well, but who in turn became still more disaffected. Ḥusām al-dīn fell a victim to the jealousy of the older amirs and was murdered on Jan. 16 1299. His short reign was marked by some fairly successful incursions into Armenia, and by a fresh survey and division of land in Egypt and Syria, which occasioned much discontent. After his murder the deposed sultan Malik al-Nāṣir, who had been living in retirement at Kerak, was reinstated by the army as sultan in Cairo (Feb. 7, 1299), though still only 14 years of age, so that public affairs were administered not by him, but by Salār the viceroy, and Bibars Jāshengir, prefect of the palace. The 7th Ilkhan, Ghazan Mahmud, took advantage of the disorder in the Mameluke empire to invade Syria in the latter half of 1299, when his forces seized several cities, including the capital Damascus, of which, however, they were unable to storm the citadel; in 1300, when a fresh army was collected in Egypt, the Mongols evacuated Damascus and made no attempt to secure their other conquests. The fear of further Mongolian invasion led to the imposition of fresh taxes in both Egypt and Syria, including one of 33% on rents, which occasioned many complaints. The invasion did not take place till 1303, when at the battle of Marj al-Ṣaffar (April 20) the Mongols were defeated. This was the last time that the Ilkhans gave the Egyptian sultans serious trouble. The fact that the Mongols were in ostensible alliance with Christian princes led to a renewal by the sultan of earlier ordinances against Jews and Christians, which led to missions from various Christian princes requesting milder terms for their co-religionists. The amirs Salār and Bibars having usurped the whole of the sultan's authority, he retired in March 1309 to Kerak, whence he sent his abdication to Cairo; in consequence of which, on April 5, 1309, *Bibars Jāshengir* was proclaimed sultan, with the title *Malik al-Moẓafar*. This prince was originally a freedman of Kalāʿūn, and was the first Circassian who ascended the throne of Egypt. Before the year was out the new sultan had been rendered unpopular by a famine, and Malik al-Nāṣir was easily able to induce the Syrian amirs to return to his allegiance, in consequence of which he re entered Cairo as sovereign on March 5, 1310. He soon found the means to execute both Bibars and Salār, while other amirs who had been eminent under the former régime fled to the Mongols. The relations between their Ilkhan and the Egyptian sultan continued strained, and for many years each court commonly entertained refugees from the other kingdom. Finally in 1322 terms of peace and alliance were agreed on between the sultan and Abū Saʿīd the 9th Ilkhan. The sultan also entered into relations with the Mongols of the Golden Horde and in 1319 married a daughter of the reigning prince Uzbeg Khan (*see* MONGOLS: *Golden Horde*). Much of Malik al-Nāṣir's third administration was spent in raids into Nubia, where he endeavoured to set up a creature of his own as sovereign, in attempts at subduing the Bedouins of south-eastern Egypt, and in persecuting the Nosairīs, whose heresy became formidable about this time. Like other Egyptian sultans he made considerable use of the Assassins, 124 of whom were sent by him into Persia to execute Kara Sonkor, at one time governor of Damascus, and one of the murderers of Malik al Ashraf but they were all outwitted by the exile who was finally poisoned by the Ilkhan in recompense for a similar service rendered by the Egyptian sultan. For a time Malik al-Nāṣir was recognized as suzerain in north Africa, the Arabian Irak, and Asia Minor, but he was unable to make any permanent conquests in any of these countries. He brought Medina, which had previously been governed by independent sherīfs, to acknowledge his authority. His diplomatic relations were more extensive than those of any previous sultan, and included Bulgarian, Indian and Abyssinian potentates, as well as the pope, the king of Aragon and the king of France. He appears to have done his utmost to protect his Christian subjects, incurring thereby the reproaches of the more fanatical Muslims, especially in the year 1320 when owing to incendiarism in Cairo there was danger of a general massacre of the Christian population. His internal administration was marked by gross extravagance, which led to his viziers being forced to practise violent extortion for which they afterwards suffered. He paid considerable attention to sheep-breeding and agriculture, and by a canal which he had dug from Fuah to Alexandria not only assisted commerce but brought 100,000 feddans under cultivation. His taste for building and street improvement led to the beautifying of Cairo, and his example was followed by the governors of other great cities in the empire, notably Aleppo and Damascus. He paid exceptionally high prices for Mamelukes, many of whom were sold by their Mongol parents to his agents, and accustomed them to greater luxury than was usual under his predecessors. In 1315 he instituted a survey of Egypt and of the 24 parts into which it was divided ten were assigned to the sultan and 14 to the amirs and the army. He took occasion to abolish a variety of vexatious imposts, and the new budget fell less heavily on the Christians than the old. Among the literary ornaments of his reign was the historian and geographer Ismaʿīl Abulfeda (*q.v.*), to whom Malik al-Nāṣir restored the government of Hamath, which had belonged to his ancestors, and even gave the title sultan. He died on June 7, 1341

With his death the decline of the Bahrī dynasty began. It lasted until 1381, when the heir of the dynasty was formally supplanted by the powerful Mameluke Barkūk, known as sultan under the title Malik al-Ẓāhir. But the 40 years before this event are marked by a succession of feeble and sometimes infant, sultans and by frequent revolutions in the palace and disorders in the provinces. Before the end the unity of the empire had become little more than superficial and its existence was threatened by Tartar hordes from further Asia.

Period of Burji Mamelukes.—After overcoming a brief reaction in favour of the older dynasty (1389–90) Barkūk entered into relations with the Ottoman sultan Bāyezīd I., and in 1394 led an army into Syria, partly as a measure preliminary to the extension of his influence further east, and partly to forestall the threatened Mongol invasion. Before the latter event occurred he died (June 20, 1399), and a young son of his, named *Faraj*, became sultan under the guardianship of two amirs. Incursions were immediately made by the Ottoman sultan into the territory of Egyptian vassals at Derendeh and Albistan (Albestin), and Malatia was besieged by his forces. Timur, who was at this time beginning his campaign against Bāyezīd, turned his attention first to Syria, and on Oct. 30, 1400, defeated the Syrian amirs near Aleppo, and soon got possession of the city and the citadel. He proceeded to take Hamah, Homs (Emesa) and other towns, and on Dec. 20 started for Damascus. An endeavour was made by the Egyptian sultan to relieve Damascus, but the news of an insurrection in Cairo caused him to retire and leave the place to its fate. In the first three months of 1401 the whole of northern Syria suffered from Timur's marauders. In the following year (Sept. 29, 1402) Timur who had in the interval inflicted a crushing defeat on the Ottoman sultan, sent to demand homage from Faraj, and his demand was readily granted, together with the delivery of the princes who had sought refuge from Timur in Egyptian territory. The death of Timur in Feb. 1405 restored Egyptian authority in Syria, which, however, became a rendezvous for all who were discontented with the rule of Faraj and his amirs, and two months after Timur's death was in open rebellion against Faraj. Although Faraj succeeded in defeating the rebels he was om-

[illegible] by insubordination on the part of his Circassian Mamelukes to abdicate (Sept. 20, 1405), when his brother *Abd al-'aziz* was proclaimed with the title *Malik al-Manṣūr*, after two months this prince was deposed and Faraj, who had been in hiding, restored. Most of his reign was, however, occupied with revolts on the part of the Syrian amirs, to quell whom he repeatedly visited Syria; the leaders of the rebels were the amirs Newruz and Sheik Maḥmūdī, afterwards sultan. Owing to disturbances and misgovernment the population of Egypt and Syria is said to have shrunk to a third in his time, and he offended public sentiment not only by debauchery, but by having his image stamped on his coins. On May 23, 1412, after being defeated and shut up in Damascus, he was compelled by Sheik Maḥmūdī to abdicate, and an Abbasid caliph, Mosta'īn, was proclaimed sultan, only to be forced to abdicate on Nov. 6 of the same year in *Sheik's* favour, who took the title *Malik al-Mu'ayyad*, his colleague Newruz having been previously sent to Syria, where he was to be autocrat by the terms of their agreement. In the struggle which naturally followed between the two, Newruz was shut up in Damascus, defeated and slain. Sheik himself invaded Asia Minor and forced the Turkoman States to acknowledge his suzerainty. After the sultan's return they soon rebelled, but were again brought into subjection by Sheik's son Ibrāhīm; his victories excited the envy of his father, who is said to have poisoned him. Sheik himself died a few months after the decease of his son (Jan. 13, 1421). After a succession of brief sultanates the amir *Barsbai* was proclaimed in 1422. This sultan avenged the attacks on Alexandria repeatedly made by Cyprian ships, by sending a fleet which burned Limasol, and another which took Famagusta (Aug. 4, 1425), but failed in the endeavour to annex the island permanently. An expedition sent in the following year (1426) succeeded in taking captive the king of Cyprus, who was brought to Cairo and presently released for a ransom of 200,000 dinars, on condition of acknowledging the suzerainty of the Egyptian sultan and paying him an annual tribute. The sultan's exactions from merchants led to a naval demonstration on the part of the Venetians, who secured better terms for their trade, and to the seizure of Egyptian vessels by the king of Aragon and the prince of Catalonia. In a census made during Barsbai's reign, it was found that the total number of towns and villages in Egypt had sunk to 2,170, whereas in the 4th century A.H. it had stood at 10,000. Much of Barsbai's attention was occupied with raids into Asia Minor, where the Dhu 'l Kadiri Turkomans frequently rebelled, and with wars against Kara Yelek, prince of Amid, and Shah Rokh, son of Timur. Barsbai died on June 7, 1438. In accordance with the custom of his predecessors he left the throne to a son still in his minority, *Abu'l-Mahāsin Yūsuf*, who took the title *Malik al-'Azīz*, but as usual after a few months he was displaced by the regent *Jakmak*, who on Sept. 9, 1438, was proclaimed sultan with the title *Malik al-Zāhir*. In the years 1442–44 this sultan sent three fleets against Rhodes, where the third effected a landing, but was unable to make any permanent conquest. In consequence of a lengthy illness Jakmak abdicated on Feb. 1, 1453, when his son *'Othman* was proclaimed sultan with the title *Malik al-Manṣūr*. Though not a minor, he had no greater success than the sons of the usurpers who preceded him, being dethroned after six weeks (March 15, 1453) in favour of the amir *Inal al-'Alā'i*, who took the title *Malik al-Ashraf*. His reign was marked by friendly relations with the Ottoman sultan Mohammed II., whose capture of Constantinople (1453) was the cause of great rejoicings in Egypt, but also by violent excesses on the part of the Mamelukes, who dictated the sultan's policy. On his death on Feb. 26, 1461, his son *Ahmad* was proclaimed sultan with the title *Malik al-Mu'ayyad*, but was compelled to abdicate on June 28, 1461, when the amir *Khoshkadam*, who had served as a general, was proclaimed sultan. Unlike the other Mameluke sovereigns, who were Turks or Circassians, this man [illegible] Greek slave.

The Turkish Conquest.—In his reign (1463) there began the struggle between the Egyptian and the Ottoman sultanates which finally led to the incorporation of Egypt in the Ottoman empire. The dispute began with a struggle over the succession in the principality of Karaman where the two sultans favoured rival candidates, and the Ottoman sultan Mohammed II. supported the claim of his candidate with force of arms, obtaining as the price of his assistance several towns in which the suzerainty of the Egyptian sultan had been acknowledged. Open war did not, however, break out between the two States in Khoshkadam's time, who died on Oct. 9, 1467, when the Atābeg *Yelbai* was selected by the Mamelukes to succeed him, and was proclaimed sultan with the title of *Malik al-Zāhir*. Proving incompetent, he was deposed by a revolution of the Mamelukes on Dec. 4, 1467, when the Atābeg *Timurbogha* was proclaimed with the title *Malik al-Zāhir*. In a month, however, another palace revolution established as sultan the new Atābeg *Kait Bey* or *Kaietbai* (Jan. 31, 1468). During his sultanate relations with the Ottoman Turks became more strained, and Bayezid II. declared war against Egypt, seizing Adana, Tarsus and other places within Egyptian territory. In 1491, however, after the Egyptians had repeatedly defeated the Ottoman troops, Kait Bey made proposals of peace which were accepted, the keys of the towns which the Ottomans had seized being restored to the Egyptian sultan. Kait Bey endeavoured to assist his co-religionists in Spain who were threatened by King Ferdinand, by threatening the pope with reprisals on Syrian Christians, but without effect. He died on Aug. 8, 1496, and a succession of brief sultanates ended in the establishment of *Kānsūh al-Ghūri* (April 1501), under whom there broke out the war which ended in the incorporation of Egypt into the Ottoman empire. Kānsūh was charged by the Ottoman sultan Selim I. with giving the envoys of the Ṣafawid Isma'il passage through Syria on their way to Venice to form a confederacy against the Turks, and with harbouring various refugees. The actual declaration of war was not made by Selin till May 1515, when the Ottoman sultan had made all his preparations; and at the battle of Merj Dabik, on Aug. 24, 1515, Kānsūh was defeated by the Ottoman forces and fell fighting. Syria passed quickly into the possession of the Turks, whose advent was in many places welcome as meaning deliverance from the Mamelukes. In Cairo, when the news of the defeat and death of the Egyptian sultan arrived, the governor who had been left by Kānsūh, *Tūmānbey*, was proclaimed sultan (Oct. 17, 1516). On Jan. 20, 1517, Cairo was taken by the Ottomans, and Selim shortly after declared sultan of Egypt. Tūmānbey continued the struggle for some months, but was finally defeated, and after being captured and kept in prison 17 days, was executed on April 15, 1517.

(D. S. MA.; F. M. S.)

III. MODERN HISTORY

The Turkish Period.—The sultan, Selim, left with his viceroy, Khair Bey, a guard of 5,000 janissaries, but otherwise made few changes in the administration of the country. The register by which a great portion of the land was a fief of the Mamelukes was maintained, and it is said that a proposal made by the sultan's vizier to appropriate these estates was punished with death. The Mameluke amirs were to be retained in office as heads of 12 sanjaks into which Egypt was divided; and under the next sultan, Suleiman I., two chambers were created, called respectively the greater and the lesser divan, in which both the army and the ecclesiastical authorities were represented, to aid the pasha by their deliberations. Six regiments altogether were constituted by the conqueror, Selim, for the protection of Egypt; to these Suleiman added a seventh, of Circassians. In 1527 the first survey of Egypt under the Ottomans was made, in consequence of the official copy of the former registers having perished by fire. Egyptian lands were divided in it into four classes—the sultan's domain, fiefs, land for the maintenance of the army, and lands settled on religious foundations.

It would seem that the constant changes in the Government caused the army to get out of control at an early period of the Ottoman occupation, and at the beginning of the 17th century mutinies became common. In 1604 the governor, Ibrahim Pasha, was murdered by the soldiers and his head set on the Bab Zuwēla; in 1609 they declared war on Mohammed Pasha. He, however, signally defeated them, and effected much-needed financial reforms. Meanwhile the prestige of the governors was threatened

in another direction; for the troubles that beset the metropolis of the Ottoman empire tended to weaken the respect of the Egyptians for its representatives at Cairo. In July 1623 there came an order from the Porte dismissing Mustafā Pasha and appointing 'Alī Pasha governor in his place. The officers met and demanded from the newly-appointed governor's deputy the customary gratuity; when this was refused they sent letters to the Porte declaring that they wished to have Mustafā Pasha and not 'Alī Pasha as governor. 'Alī Pasha's efforts, on landing, to assert himself were unsuccessful, and soon after a rescript arrived from Constantinople, confirming Mustafā Pasha in the governorship. Similarly, in 1631, when the army took upon themselves to depose the governor, Mūsā Pasha, in indignation at his execution of Kitās Bey, an officer who was to have commanded an Egyptian force required for service in Persia, the Porte approved the conduct of the army and appointed one Khalīl Pasha as Mūsā's successor. Not only was the governor unsupported by the sultan against the troops, but each new governor regularly inflicted a fine upon his outgoing predecessor, under the name of money due to the treasury; and the outgoing governor was not allowed to leave Egypt till he had paid it. Besides the extortions to which this practice gave occasion the country suffered greatly from famine and pestilence The latter, in the spring of 1619, is said to have carried off 635,000 persons, and in 1643 completely desolated 230 villages.

BY COURTESY OF THE NEAR EAST RELIEF

AN EGYPTIAN NEAR CAIRO

Rise of the Beys.—By the 18th century the importance of the pasha was quite superseded by that of the beys, and two offices, those of Sheikh al-Balad and Amīr-al-Ḥājj, which were held by these persons, represented the real headship of the community. In 1707 the Sheikh al-Balad, Qāsim Iywāz headed one of two Mameluke factions, the Qāsimites and the Fiqārites, between whom the seeds of enmity were sown by the pasha of the time, with the result that a fight took place between the factions outside Cairo, lasting 80 days. His son Ismā'īl, who succeeded him and held office for 16 years while the pashas were constantly being changed, reconciled the two factions of Mamelukes. Ismā'īl was assassinated in 1724, and the next two successors who fought their way into his place shared the same fate. Then came Ottoman Bey, who governed with wisdom and moderation, but was forced to fly from Egypt by the intrigues of two adventurers, Ibrāhīm and Riḍwān Bey. They, when their scheme had succeeded, began a massacre of beys and others thought to be opposed to them; they then proceeded to govern Egypt jointly, holding the two offices mentioned above in alternate years. More than one pasha failed to rid himself of them, but at last the murder of Ibrāhīm Bey took place in 1755; and his colleague, Riḍwān, perished in the disputes that followed upon it.

'Alī Bey.—'Alī Bey, a former protegé of Ibrāhīm's, set himself the task of avenging the death of his master, and spent eight years in purchasing Mamelukes and winning other adherents. He thereby excited the suspicions of the Sheikh al-Balad Khalīl Bey, who drove him out of Cairo, but was eventually overpowered, sent to Alexandria and finally strangled. The date of 'Alī Bey's victory was 1164 A.H. (A.D. 1750), and after it he was made Sheikh al-Balad. In that capacity he executed the murderer of his former master, Ibrāhīm; but the resentment which this act aroused among the beys caused him to leave his post and fly to Syria, where the governor of Acre, Ẓāhir b. Omar, obtained for him the goodwill of the Porte and reinstatement in his post as Sheikh al-Balad. In 1766, after the death of his supporter, the grand vizier, Rāghib Pasha, he was again compelled to fly from Egypt to Yemen, but in the following year his party at Cairo was strong enough to permit of his return. Resuming his office, he raised 18 of his friends to the rank of bey among them Ibrahim and Murad, who were afterwards at the head of affairs, as well as Mohammed Abu'l-Dhahab, who was closely connected with the rest of 'Alī Bey's career. In 1769 the Porte called on him to furnish a force of 12,000 men to be employed in the Russian war. It was suggested, however, at Constantinople that 'Alī would employ this force when he collected it for securing his own independence, and a messenger was sent by the Porte to the pasha with orders for his execution. 'Alī, being apprised by his agents at the metropolis of the despatch of this messenger, ordered him to be waylaid and killed; the despatches were seized and read by 'Alī before an assembly of the beys, who were assured that the order for execution applied to all alike, and he urged them to fight for their lives His proposals were received with enthusiasm by the beys whom he had created. Egypt was declared independent and the pasha given 48 hours to quit the country. Ẓāhir Pasha of Acre, to whom was sent official information of the step taken by 'Alī Bey, promised his aid and kept his word by compelling an army sent by the pasha of Damascus against Egypt to retreat. Within six months 'Alī Bey had subjugated the greater part of the Arabian peninsula and appointed as sherīf of Mecca a cousin of his own, who bestowed on him by an official proclamation the titles sultan of Egypt and khākān of the Two Seas. He then, in virtue of this authorization, struck coins in his own name (1185 A.H.) and ordered his name to be mentioned in public worship.

His next move turned out fatally, Abu'l-Dhahab was sent with a force of 30,000 men (A.D. 1771) to conquer Syria; and agents were sent to negotiate alliances with Venice and Russia. Abu l-Dhahab's progress through Palestine and Syria was triumphant, but, after capturing Damascus, he entered into secret negotiations with the Porte, by which he undertook to restore Egypt to Ottoman suzerainty. He then proceeded to evacuate Syria, and marched with all the forces he could collect to Upper Egypt, occupying Assiut in April 1772. Ismā'īl Bey was sent by 'Alī Bey with a force of 3,000 to check his advance; but at Bāsātīn Ismā'īl with his troops joined Abu'l-Dhahab. 'Alī Bey received information to the effect that his friend Ẓāhir of Acre was willing to give him refuge, and left Cairo for Syria (April 8, 1772), one day before the entrance of Abu'l-Dhahab.

At Acre 'Alī's fortune seemed to be restored. A Russian vessel anchored outside the port, and supplied him with stores and ammunition, and a force of 3,000 Albanians. He sent one of his officers, 'Alī Bey al-Tanṭāwī, to recover the Syrian towns evacuated by Abu'l-Dhahab, and now in the possession of the Porte. He himself took Jaffa and Gaza, the former of which he gave to his friend Ẓāhir of Acre. In Feb 1773 he started for Egypt at the head of an army of 8,000 men, and on April 19 met the army of Abu l-Dhahab at Sālihia. 'Alī's forces were successful at the first engagement; but when the battle was renewed two days later he was deserted by some of his officers, and prevented by illness and wounds from himself taking the conduct of affairs. The result was a complete defeat for his army, after which he declined to leave his tent; he was captured after a brave resistance, and taken to Cairo, where he died seven days later.

After 'Alī Bey's death Egypt became once more a dependency of the Porte, governed by Abu'l-Dhahab as Sheikh al-Balad with the title pasha. He shortly afterwards received permission from the Porte to invade Syria, with the view of punishing 'Alī Bey's supporter Ẓāhir, and in the course of the campaign he died. One of his deputies, Ismā'īl Bey, now became Sheikh al-Balad, but was soon involved in a dispute with Ibrāhīm and Murād, two of the colleagues of 'Alī Bey who had deserted him at Sālihia. They after a time succeeded in driving Ismā'īl out of Egypt and establishing a joint rule (as Sheikh al-Balad and Amīr al-Ḥājj respectively) similar to that which had been tried previously. In 1786 an expedition was sent by the Porte to restore Ottoman supremacy in Egypt; and Ismā'īl Bey was again made Sheikh al-Balad and a new pasha installed as governor. In Jan. 1791 a terrible plague began to rage in Cairo and elsewhere in Egypt, to which Ismā'īl Bey and most of his family fell victims. Owing to the need for competent rulers Ibrāhīm and Murād Bey were sent for and reinstated in their dual government. These two persons were still in office when Bonaparte entered Egypt.

Literature.—[illegible] *Khiṭaṭ wa'l-Qāhirah* (Cairo, 1321 A.H.) contains the names of persons like Mutanabbī, who stayed there for a short time in the service of some patron; Abū Tammām, who lived there before he acquired fame as a poet; 'Umāra of Yemen, who came there at a mature age to spend some years in the service of Fāṭimite viziers; each of whom figures in lists of authors belonging to some other country also. So long as the centre of the Islamic world was not in Egypt, the best talent was attracted elsewhere, but after the fall of Baghdad, Cairo became the chief seat of Islamic learning, and this rank, chiefly owing to the university of Azhar, it has ever since continued to maintain. There is consequently a long and distinguished list of Arabic historians of Egypt, from Ibn 'Abd al-Ḥakam, in the 3rd Islamic century to 'Abd al-Raḥmān Jabartī, in the 13th. Of many of the Mameluke sultans there are special chronicles preserved in various European and oriental libraries. To these there should be added the Survey of Egypt, called *al-tuḥfah al-saniyyah* of Ibn Jī'ān, belonging to the time of Kait Bey; the treatise on the Egyptian constitution called *Zubdat Kashf al-Mamālik*, by Khalīl al-Ẓāhirī, of the same period; and the encyclopaedic work on the same subject called *Ṣubḥ al-Inshā*, by al-Qalqashandī, d. 821.

Arabic poetry is in the main encomiastic and personal, and from the beginning of the Omayyad period sovereigns and governors paid poets to celebrate their achievements; of those of importance who are connected with Egypt there is again a lengthy list from the 2nd to the 9th centuries. Poets distinguished for special lines are al-Ḥakim b. Dāni'āl, d. 603, author of the Shadow-play; and al-Būṣīrī (Mohammed b. Sa'īd), d. 694, author of the ode in praise of the prophet called Burdah. A list of poets of the 11th century is given by Khafājī in his *Raiḥānat al-alibbā*.

The needs of the Egyptian court produced a number of elegant letter-writers, of whom the most famous were 'Abd al-Raḥīm b. 'Alī al-Baisānī, ordinarily known as al-Qāḍī 'al-Fāḍil, d. 596, secretary of State to Saladin and other Ayyūbite sultans; 'Imād al-dīn al-Işpahānī, d. 597, also secretary of State and official chronicler; and Ibn 'Abd al-Ẓāhir, d. 692, secretary of State to Bibars I. and succeeding sultans; he was followed by his son Fatḥ al-dīn, to whom the title "Secret writer" was first given.

In the subject of law Egypt boasts that the Imām Shāfi'ī, founder of one of the schools, resided at Fosṭāṭ from 195 till his death in 204; his system, though displaced for a time by that invented by the Fāṭimites, and since the Turkish conquest by the Ḥanifite system, has always been popular in Egypt.

Among Egyptian mystics the most famous as authors are the poet Ibn al-Fāriḍ, d. 632, and Abd al-Wahhāb Shabrānī, d. 973. Abu'l-Ḥasan al-Shādhilī (d. 656) is celebrated as the founder of the Shādhilī order; but there were many others of note. The dictionary of physicians, compiled in the 7th century, enumerates nearly 60 men of science who resided in Egypt; the best-known among them are Sa'īd b. Bitrīq, Moses Maimonides and Ibn Baiṭār. Of Egyptian miscellaneous writers two of the most celebrated are Ibn Daqīq al-'īd, d. 702, and Jalāl al-dīn Suyūṭī.

(D. S. Ma.; Me.)

The French Occupation.—Although in reality a move in Napoleon's great game of world domination, the French expedition to Egypt had, as its ostensible object, the reinstatement of the authority of the Sublime Porte, and the suppression of the Mamelukes. In the proclamation printed with the Arabic types brought from the Propaganda press, and issued shortly after the taking of Alexandria, Bonaparte declared that he reverenced the prophet Mohammed and the Koran far more than the Mamelukes reverenced either, and argued that all men were equal except so far as they were distinguished by their intellectual and moral excellences, of neither of which the Mamelukes had any great store. In future all posts in Egypt were to be open to all classes of the inhabitants; the conduct of affairs was to be committed to the men of talent, virtue and learning; and in proof of the statement that the French were sincere Muslims the overthrow of the papal authority in Rome was alleged. After the battle of Ambabah, at which the forces of both Murād Bey and Ibrāhīm Bey were dispersed, the populace readily plundered the houses of the beys, and a deputation was sent from al-Azhar to Bonaparte to ascertain his intentions; these proved to be a repetition of the terms of his proclamation, and, though the combination of loyalty to the French with loyalty to the sultan was unintelligible, a good understanding was at first established between the invaders and the Egyptians. The destruction of the French fleet, however, at the battle of the Nile, and the failure of the French forces sent to Upper Egypt (where they reached the first cataract) to obtain possession of the person of Murād Bey, shook the faith of the Egyptians in their invincibility; and in consequence of a series of unwelcome innovations, an insurrection broke out in Cairo on Oct. 22, 1798, of which the headquarters were in the Muslim university of Azhar. On this occasion the French general Dupuy, lieutenant-governor of Cairo, was killed. The prompt measures of Bonaparte, aided by the arrival from Alexandria of Gen. J. B. Kléber, quickly suppressed this rising; but the stabling of the French cavalry in the mosque of Azhar gave great and permanent offence. On Dec. 25 a proclamation was issued, reconstituting the two divans which had been created by the Turks, the special divan was to consist of 14 persons chosen by lot out of 60 government nominees, and was to meet daily. The general divan was to consist of functionaries, and to meet on emergencies.

Napoleon's ill-fated expedition to Syria followed, but in July 1799 he retrieved his fortunes by a crushing defeat of the Turkish army that had landed at Aboukir, aided by the British fleet commanded by Sir Sidney Smith. Shortly after his victory Bonaparte left Egypt, having appointed Kléber to govern in his absence, which he informed the sheikhs of Cairo was not to last more than three months. A double expedition shortly after Bonaparte's departure was sent by the Porte for the recovery of Egypt, one force being despatched by sea to Damietta, while another under Yūsuf Pasha took the land route from Damascus by al-Arish. Over the first some success was won, in consequence of which the Turks agreed to a convention (signed Jan. 24, 1800), by virtue of which the French were to quit Egypt. The Turkish troops advanced to Bilbeis, where they were received by the sheikhs from Cairo, and the Mamelukes also returned to that city from their hiding-places. Before the preparations for the departure of the French were completed, orders came to Sir Sidney Smith from the British Government, forbidding the carrying out of the convention unless the French army were treated as prisoners of war; and when these were communicated to Kléber he cancelled the orders previously given to the troops, and proceeded to put the country in a state of defence. In June, however, he was assassinated by a fanatic named Suleiman of Aleppo, said to have been incited to the deed by a Janissary refugee at Jerusalem. The command of the army then devolved on Gen. J. F. (Baron de) Menou (1750–1810), a man who had professed Islam, and achieved some popularity, counteracted, however, by his declaration of a French protectorate over Egypt, which was to count as a French colony.

French Evacuation.—In the first weeks of March 1801 the English, under Sir R. Abercromby, effected a landing at Aboukir, and proceeded to invest Alexandria, where on the 21st they were attacked by Menou; the French were repulsed, but the English commander was mortally wounded in the action. On the 25th fresh reinforcements arrived under Husain, the Kapudan Pasha, or high admiral; and a combined English and Turkish force was sent to take Rosetta. On May 30, Gen. A. D. Belliard, who had been left in charge at Cairo, was assailed on two sides by the British forces under Gen. John Hely Hutchinson (afterwards 2nd earl of Donoughmore), and the Turkish under Yūsuf Pasha; after negotiations Belliard agreed to evacuate Cairo and to sail with his 13,734 troops to France. On Aug. 30, Menou at Alexandria was compelled to accept similar conditions, and his force of 10,000 left for Europe in September. This was the termination of the French occupation of Egypt.

Soon after the evacuation of Egypt by the French, the country became the scene of more severe troubles, in consequence of the attempts of the Turks to destroy the power of the Mamelukes. In defiance of promises to the British Government, orders were trans-

mitted from Constantinople to Hussan Pasha the Turkish high admiral to ensnare and put to death the principal beys. Invited to an entertainment they were either attacked on board the flagship or fired upon in open boats, in the Bay of Aboukir. They offered an heroic resistance, but were overpowered, and some killed, some made prisoners, among the last was Osman Bey al-Bardīsī, who was severely wounded. Gen. Hutchinson, informed of this treachery, immediately assumed threatening measures against the Turks, and in consequence the killed, wounded and prisoners were given up to him. At the same time Yūsuf Pasha arrested all the beys in Cairo, but was shortly compelled by the British to release them. Such was the beginning of the disastrous struggle between the Mamelukes and the Turks.

In March 1803 the British evacuated Alexandria, and Mohammed Bey al-Alfī accompanied them to England to consult respecting the means to be adopted for restoring the former power of the Mamelukes. About six weeks after, the Arnaut (or Albanian) soldiers in the service of the Turkish governor, Mohammed Khosrev, tumultuously demanded their pay, and surrounded the house of the defterdār (or finance minister), who in vain appealed to the pasha to satisfy their claims. The latter opened fire from the artillery of his palace on the insurgent soldiery in the house of the defterdār, across the Ezbekia. Tāhir, the commander of the Albanians, then repaired to the citadel, gained admittance through an embrasure, and, having obtained possession of it, began to cannonade the pasha over the roofs of the intervening houses, and then descended with guns to the Ezbekia and laid close siege to the palace. On the following day Mohammed Khosrev made good his escape, with his women and servants and his regular troops, and fled to Damietta by the river. This revolt marks the beginning in Egypt of the breach between the Albanians and Turks, which ultimately led to the expulsion of the latter, and of the rise to power of the Albanian Mehemet Ali (Mohammed Ali, *q.v.*), who was destined to rule the country for nearly 40 years and be the cause of serious European complications.

Rise of Mehemet Ali.—Tāhir Pasha assumed the government, but in 23 days he was assassinated. A desperate conflict ensued between the Albanians and Turks; and the palace was set on fire and plundered. The masters of Egypt were now split into these two factions, animated with the fiercest animosity against each other. Mehemet Ali, then in command of an Albanian regiment, became the head of the former, but his party was the weaker, and he therefore entered into an alliance with the Mameluke leaders, Ibrahim Bey and 'Osmān Bey al-Bardīsī. The Mamelukes were reinstated in the citadel, and the allies marched against Khosrev Pasha, who having been joined by a considerable body of Turks, and being in possession of Damietta, was enabled to offer an obstinate resistance. After much loss on both sides, he was taken prisoner and brought to Cairo; but he was treated with respect. The victorious soldiery sacked the town of Damietta, and were guilty of the barbarities usual with them on such occasions.

A few days later, Ali Pasha Jazāirli landed at Alexandria with an imperial firmān, constituting him pasha of Egypt, and threatened the beys, who now were virtual masters of Upper Egypt, as well as of the capital and nearly the whole of Lower Egypt. Mehemet Ali and al-Bardīsī therefore descended to Rosetta, which had fallen into the hands of a brother of Ali Pasha, captured the town and its commander, and returned to Cairo. The troubles of Egypt were now increased by an insufficient inundation, and great scarcity prevailed, aggravated by the taxation to which the beys were compelled to resort in order to pay the troops; while murder and rapine prevailed in the capital, the riotous soldiery being under little or no control. Meanwhile, Ali Pasha had been endeavouring to set the Albanians and the Mamelukes against each other, by intriguing with each separately. He failed, however, and his troops refusing to support him, he surrendered to the beys, while his army was compelled to retire to Syria. In the hands of the beys Ali Pasha again attempted treachery. This offered a fair pretext to the Mamelukes to rid themselves of a man proved to be a perfidious tyrant. He was sent under a guard of 45 men towards the Syrian frontier; and about a week later news was received that in a skirmish with some of his own soldiers he had fallen mortally wounded.

The death of Ali Pasha produced only temporary tranquillity; in a few days (Feb. 12, 1804) the return of Mohammed Bey al-Alfī (called the Great) from England was the signal for fresh disturbances, which, by splitting the Mamelukes into two parties, accelerated their final overthrow. An ancient jealousy existed between al-Alfī and the other most powerful bey, al-Bardīsī, who took active measures to oppose his return. Husain Bey (a relative of al-Alfī) was assassinated by emissaries of al-Bardīsī, and Mehemet Ali, with his Albanians, gained possession of Giza, which had been occupied by al-Alfī's partisans. Al-Alfī himself on his way to Cairo encountered a party of Albanians, and with difficulty made his escape to the desert. A change in the fortune of al-Bardīsī, however, favoured his plans for the future. That chief, in order to satisfy the demands of the Albanians for their pay, gave orders to levy heavy contributions from the citizens of Cairo; and this new oppression roused them to rebellion. The Albanians, alarmed for their safety, assured the populace that they would not allow the order to be executed; and Mehemet Ali himself caused a proclamation to be made to that effect. Thus the Albanians became the favourites of the people, and took advantage of their opportunity. Seizing the citadel, they once more proclaimed Mohammed Khosrev pasha of Egypt. For one day and a half he enjoyed the title; the friends of the late Tāhir Pasha then accomplished his second degradation, and Cairo was again the scene of terrible enormities, the Albanians revelling in the houses of the Mameluke chiefs, whose harems met with no mercy at their hands. These events were the signal for the reappearance of al-Alfī.

The Albanians now invited Ahmed Pasha Khorshīd to assume the reins of government, and he without delay proceeded from Alexandria to Cairo. The forces of the partisans of al-Bardīsī had established a blockade of the city on the south, and were now ravaging the country on the north. Al-Alfī and Osman Bey had also declared against the pasha and advanced on Cairo, which was in a state of tumult and semi-starvation. At Shubra, however, a northern suburb, a pitched battle was fought in which the Mamelukes were defeated with heavy loss on both sides. This reverse in a measure united the two great Mameluke parties, though their chiefs remained at enmity. The Mamelukes gradually retreated towards Upper Egypt. Thither the pasha despatched three successive expeditions (one of which was commanded by Mehemet Ali) without decisive result.

At this period another calamity befell Egypt; about 3,000 Delīs (Kurdish troops) arrived in Cairo from Syria. These troops had been sent for by Khorshīd in order to strengthen himself against the Albanians; and the events of this portion of the history afford sad proof of their ferocity and brutal enormities, in which they far exceeded the ordinary Turkish soldiers and even the Albanians. Their arrival immediately recalled Mehemet Ali and his party from the war, and instead of aiding Khorshīd was the proximate cause of his overthrow.

Mehemet Ali Made Pasha.—Cairo was ripe for revolt; the pasha was hated for his tyranny and extortion, and execrated for the deeds of his troops, especially those of the Delīs: the ulemā prepared a formal statement of their wrongs and went with it (May 13, 1805) to Mehemet Ali and informed him that the people would no longer submit to Khorshīd. "Then whom will ye have?" said he. "We will have *thee*," they replied, "to govern us according to the laws; for we see in thy countenance that thou art possessed of justice and goodness." Mehemet Ali seemed to hesitate, and then complied, and was at once invested. On this, a bloody struggle began between the two pashas. Khorshīd was besieged by the Albanians in the citadel, from which he bombarded the town. The struggle went on, with intervals on Fridays, until a messenger from Constantinople brought a *firmān* confirming Mehemet Ali and ordering Khorshīd to go to Alexandria, there to await further orders; but this he refused to do, on the ground that he had been appointed by a *hatt-i-sherīf*. The firing ceased on the following day, but the troubles of the people were rather increased than assuaged; murders and robberies were daily com

[illegible] sone of the [illegible] were being [illegible] Demanhur, and the other beys were returning towards Cairo. Khorshid having called them to his assistance, but Mehemet Ali forced them to retreat. At this point a squadron under the command of the Turkish high admiral arrived at Aboukir bay, with despatches confirming the *firmān* brought by the former envoy, and authorizing Mehemet Ali to continue to discharge the functions of governor. Khorshid at first refused to yield but at length, on condition that his troops should be paid, he evacuated the citadel and embarked for Rosetta.

Mehemet Ali now possessed the title of governor of Egypt, but beyond the walls of Cairo his authority was everywhere disputed by the beys, who were joined by the army of the silāhdār of Khorshid; and many Albanians deserted from his ranks. To replenish his empty coffers he was also compelled to levy exactions, principally from the Copts. In these extremes he made an attempt to exterminate certain of the beys, who were encamped north of Cairo. On Aug. 17, 1805, having been induced by simulated treachery to enter the city, they marched along the principal street for some distance, with kettle-drums behind each company, and were received with apparent joy by the citizens. At the mosque called the Ashrafia they separated, one party proceeding to the Azhar and the other continuing along the main street, and through the gate called Bāb Zuwēla, where they turned up towards the citadel. Here they were fired on by some soldiers from the houses; and with this signal a terrible massacre began. Some sought refuge in the collegiate mosque Barkukia, while the remainder fought their way through their enemies and escaped over the city-wall. Two Mamelukes had in the meantime succeeded in giving the alarm to their comrades in the quarter of the Azhar, who escaped by an eastern gate. A horrible fate awaited those who had shut themselves up in the Barkukia. Having begged for quarter and surrendered, they were immediately stripped nearly naked, and about 50 were slaughtered on the spot; about the same number were dragged away, with every brutal aggravation of their pitiful condition, to Mehemet Ali, chained and left in the court of the pasha's house. On the following morning the heads of their comrades who had perished the day before were skinned and stuffed with straw before their eyes. One bey and two others paid their ransom and were released; the rest, without exception, were tortured and put to death in the course of the ensuing night. Thus ended Mehemet Ali's first massacre of his too confiding enemies.

In consequence of the remonstrances of the English, and a promise made by al-Alfi of 1,500 purses, the Porte consented to reinstate the beys of the 24 provinces, and to place al-Alfi at their head; but this measure met with the opposition of Mehemet Ali and the determined resistance of the majority of the Mamelukes, who, rather than have al-Alfi at their head, preferred their present condition; for the enmity of al-Bardisi had not subsided, and he commanded the voice of most of the other beys. Al-Alfi was at the time besieging Demanhur, and he gained a signal victory over the pasha's troops; but the dissensions of the beys destroyed their last chance of a return to power. Al-Alfi and his partisans were unable to pay the sum promised to the Porte; Sālih Pasha, who had brought a Turkish force to Alexandria to depose Mehemet Ali, was placated by a payment of 4,000 purses to the Porte; Mehemet Ali was continued in his post, and the reinstatement of the beys was abandoned. Fortune continued to favour the pasha. In the following month al-Bardisi died, aged 48 years; and soon after, a scarcity of provisions excited the troops of al-Alfi to revolt. That bey very reluctantly raised the siege of Damanhur, being in daily expectation of the arrival of an English army; and died suddenly on Jan. 30, 1807, at the age of 55. Thus was the pasha relieved of his two most formidable enemies; and shortly after he defeated Shāhīn Bey, with the loss to the latter of his artillery and baggage and [illegible] men killed or taken prisoners.

The British Expedition of 1807.—On March 17 1807 a British force [illegible] Alexandria, having on board nearly 5,000 [illegible] the command of Gen. [illegible] them. Here they first heard of the death of al-Alfi, upon whose co-operation they had founded their chief hopes of success; and they immediately dispatched messengers to his successor and to the other beys, inviting them to Alexandria. Mehemet Ali countered by promising the beys to comply with all their demands if they would join him in expelling the invaders. To this they acceded. Meanwhile a detachment of Fraser's force under Gens Wauchope and Meade, had been ambuscaded in Rosetta, and effected a retreat on Aboukir and Alexandria, after a very heavy loss of 185 killed and 281 wounded, Gen. Wauchope and three officers being among the former, and Gen. Meade and 19 officers among the latter. The heads of the slain were fixed on stakes on each side of the road crossing the Ezbekīa in Cairo. A second attack on Rosetta failed disastrously. On April 20, news having come in from the advanced guard at Hamād of large reinforcements to the besieged, Gen. Stewart was compelled to retreat; and the advanced guard, consisting of 733 men, was surrounded, and, after a gallant resistance, the survivors, who had expended all their ammunition, became prisoners of war. Gen Stewart regained Alexandria with the remainder of his force, having lost, in killed, wounded and missing, nearly 900 men. Some hundreds of British heads were now exposed on stakes in Cairo, and the prisoners were marched between these mutilated remains of their countrymen. On Sept. 14 Gen. Fraser evacuated Alexandria.

Extermination of the Mamelukes.—Concessions to the beys then became the pasha's policy, and many of them took up their abode in Cairo, but tranquillity was not secured; several times they met the pasha's forces in battle and once gained a signal victory. Early in the year 1811, the preparations for an expedition against the Wahhābīs in Arabia being complete, all the Mameluke beys then in Cairo were invited to the ceremony of investing Mehemet Ali's favourite son, Tūsūn, with a pelisse and the command of the army. As on the former occasion, the unfortunate Mamelukes fell into the snare. On March 1, Shāhīn Bey and the other chiefs (one only excepted) repaired with their retinues to the citadel, and were courteously received by the pasha. Having taken coffee, they formed in procession, and, preceded and followed by the pasha's troops, slowly descended the steep and narrow road leading to the great gate of the citadel; but as soon as the Mamelukes arrived at the gate it was suddenly closed before them; and a heavy fire was opened on them from above and behind. Of the betrayed chiefs, many were laid low in a few moments; some, dismounting, and throwing off their outer robes, vainly sought, sword in hand, to return, and escape by some other gate. The few who regained the summit of the citadel experienced the same fate as the rest, for no quarter was given. Four hundred and seventy Mamelukes entered the citadel; and of these very few, if any, escaped. This massacre was the signal for an indiscriminate slaughter of the Mamelukes throughout Egypt, orders to this effect being transmitted to every governor; and in Cairo itself the houses of the beys were given over to the soldiery. A remnant of the Mamelukes fled to Nubia, and a tranquillity was restored to Egypt to which it had long been unaccustomed. In the year following the massacre the unfortunate exiles were attacked by Ibrahim Pasha, the eldest son of Mehemet Ali, in the fortified town of Ibrīm, in Nubia. Here the want of provisions forced them to evacuate the place; a few who surrendered were beheaded, and the rest went farther south and built the town of New Dongola (correctly Dunkulah), where the venerable Ibrahim Bey died in 1816, at the age of 80.

(X.; Me.)

Rule of Mehemet Ali.—Mehemet Ali was now undisputed master of Egypt, and his efforts henceforth were directed primarily to the maintenance of his practical independence. The suzerainty of the sultan he acknowledged, and at the reiterated commands of the Porte he despatched, in 1811, an army of 8,000 men, including 2,000 horse, under the command of his son Tūsūn, a youth of 16, against the Wahhābīs (*q.v.*) After two campaigns of varying fortune, Mehemet Ali took the field in person he deposed and exiled the sherif of Mecca and after the death of the Wah-

om Elba and fear ng danger o Egyp from the plans of F an e o Great Br ta n Mehemet Ali re urned to Ca ro by wa o. Kosse r and Kena His return was hastened by reports that the Turks, whose cause he was upholding in Arabia, were treacherously planning an invasion of Egypt.

During Mehemet Ali's absence in Arabia his representative at Cairo had completed the confiscation, begun in 1808, of almost all the lands belonging to private individuals, who were forced to accept instead inadequate pensions. By this revolutionary method of land "nationalization" Mehemet Ali became proprietor of nearly all the soil of Egypt, an iniquitous measure against which the Egyptians had no remedy. The attempt which in this year (1815) the pasha made to reorganize his troops on European lines led, however, to a formidable mutiny in Cairo. This brought Tūsūn back to Egypt; but he died in 1816 at the early age of 20. Mehemet Ali, dissatisfied with the treaty concluded with the Wahhābīs, and with the non-fulfilment of certain of its clauses, determined to send another army to Arabia, and to include in it the soldiers who had recently proved unruly. This expedition, under his eldest son, Ibrahim Pasha, left in the autumn of 1816 The war was long and arduous, but in 1818 Ibrahim captured the Wahhābī capital of Deraiya. Abdullah, their chief, was made prisoner, and with his treasurer and secretary was sent to Constantinople, where, in spite of Ibrahim's promise of safety, and of Mehemet Ali's intercession in their favour, they were put to death. At the close of the year 1819, Ibrahim returned to Cairo, having subdued all present opposition in Arabia.

Meanwhile the pasha had turned his attention to the improvement of the manufactures of Egypt, and engaged very largely in commerce. He created for himself a monopoly in the chief products of the country, to the further impoverishment of the people, and set up and kept going for years factories which never paid. But some of his projects were sound, such as the excavation (1819–20) of the Mahmudiya canal, to establish a safe channel between Alexandria and the Nile. The sacrifice of life, however, was enormous (fully 20,000 workmen perished), and the labour of the unhappy fellahin was forced. Another notable fact in the economic progress of the country was the development of the cultivation of cotton in the Delta in 1822 and onwards. The cotton grown had been brought from the Sudan by Maho Bey, and the organization of the new industry—from which in a few years Mehemet Ali was enabled to extract considerable revenues—was entrusted to a Frenchman named Jumel.

In 1820 Mehemet Ali ordered the conquest of the eastern Sudan to be undertaken; it was his ambition to capture the valuable caravan trade then going towards the Red sea, and to secure the rich gold mines which he believed to exist in Sennār. He also saw in the campaign a means of getting rid of the disaffected troops, and of obtaining a sufficient number of captives to form the nucleus of the new army. Nubia, Sennār and Kordofan were reduced; Khartoum was founded, and in the following years the rule of the Egyptians was largely extended and control obtained of the Red sea ports Suakin and Massawa (*see* SUDAN, *History*).

In 1824 a native rebellion of a religious character broke out in Upper Egypt headed by one Ahmad, an inhabitant of Es-Sālimiya, a village situated a few miles above Thebes. He proclaimed himself a prophet, and was soon followed by between 20,000 and 30,000 insurgents, mostly unarmed peasants. The insurrection was crushed by Mehemet Ali, and proved the last internal attempt to destroy the pasha's authority.

The fellahin, a patient, long-suffering race save when stirred by religious fanaticism, submitted to the kurbash, freely used by the Turkish and Bashi Bazuk tax-gatherers employed by Mehemet Ali to enforce his system of taxation, monopolies, corvée and conscription. Under this régime the resources of the country were impoverished, while the finances fell into complete and incomprehensible chaos. This is how Egypt in 1838 appeared to the British consul-general, Col. Campbell:—

"The Government (he wrote), possessing itself of the necessaries of life at prices fixed by itself, disposes of them at arbitrary prices. The fellah is thus deprived of his harvest and falls into arrears with his taxes, and is harassed and bastinadoed to force h m to pa h s deb Tn s leads to deterioration of agriculture and lessens the production The pasha having imposed high taxes has caused the high prices of the necessaries of life. It would be difficult for a foreigner now coming to Egypt to form a just idea of the actual state of the country as compared with its former state. In regard to the general rise in prices, all the ground cultivated under the Mamelukes was employed for producing food—wheat, barley beans, etc.—in immense quantities. The people reared fowls sheep, goats, etc., and the prices were one-sixth, or even one-tenth of those at present. This continued until Mehemet Ali became viceroy in 1805. From that period until the establishment of monopolies prices have gradually increased; but the great increase has chiefly taken place since 1824, when the pasha established his regular army, navy and factories."

This picture of Egypt under Mehemet Ali is, nevertheless, not complete without regard being had to the beneficent side of his rule. Public order was rendered perfect: the Nile and the highways were secure to all travellers. Christian or Muslim; the Bedouin tribes were won over to peaceful pursuits, and genuine efforts were made to promote education and the study of medicine. To European merchants, on whom he was dependent for the sale of his exports, Mehemet Ali showed much favour, and under his influence the port of Alexandria again rose into importance. It was also under Mehemet Ali's encouragement that the overland transit of goods from Europe to India via Egypt was resumed.

Campaigns in Greece and Syria.—Mehemet Ali was fully conscious that the empire which he had so laboriously built up might at any time have to be defended by force of arms against his master, Sultan Mahmud II, and he was determined to anticipate the sultan in the creation of a fleet and an army on modern lines, partly as a measure of precaution, partly as an instrument for the realization of yet wider schemes of ambition. Before the outbreak of the War of Greek Independence in 1821 he had already expended much time and energy in organizing a fleet and in training, under the supervision of French instructors, native officers and artificers; though it was not till 1829 that the opening of a dockyard and arsenal at Alexandria enabled him to build and equip his own vessels. By 1823, moreover, he had succeeded in carrying out the reorganization of his army on European lines, the turbulent Turkish and Albanian elements being replaced by negroes and fellahin. His foresight was rewarded by the invitation of the sultan to help him in the task of subduing the Greek insurgents, offering as reward the pashaliks of the Morea and of Syria. Mehemet Ali had already, in 1821, been appointed governor of Crete, which he had occupied with a small Egyptian force. In the autumn of 1824 a fleet of 60 Egyptian warships carrying a large force of disciplined troops concentrated in Suda bay, and, in the following March, Ibrahim as commander-in-chief landed in the Morea. But for the action of European Powers the intervention of Mehemet Ali would have been decisive. His naval superiority wrested from the Greeks the command of the sea, on which the fate of the insurrection ultimately depended, while on land the Greek irregular bands were everywhere routed by Ibrahim's disciplined troops. The history of the events that led up to the battle of Navarino and the liberation of Greece is told elsewhere (*see* NAVARINO and GREEK INDEPENDENCE, WAR OF); the withdrawal of the Egyptians from the Morea was ultimately due to the action of Admiral Sir Edward Codrington, who early in Aug. 1828 appeared before Alexandria and induced the pasha to sign a convention undertaking to recall Ibrahim and his army.

Before the final establishment of the new kingdom of Greece, the Eastern question had, late in 1831, entered into a new and more perilous phase, owing to the revolt of Mehemet Ali against the sultan on pretext of chastising the ex-slave Abdullah, pasha of Acre, for refusing to send back Egyptian fugitives from the effects of Mehemet Ali's "reforms." For ten years from this date the relations of sultan and pasha remained in the forefront of the questions which agitated the diplomatic world. It was not only the very existence of the Ottoman empire that seemed to be at stake, but Egypt itself had become more than ever an object of attention, to British statesmen especially, and in the issue of the struggle were involved the interests of Great Britain in the two routes

India by the Isthmus of Suez and the valley of the Euphrates. The victorious career of Ibrahim, who once more commanded in his father's name, beginning with the storming of Acre on May 27, 1832, and culminating in the rout and capture of Reshid Pasha at Konia on Dec. 21, was arrested by the intervention of Russia. As the result of endless discussions between the representatives of the Powers, the Porte and the pasha, the Convention of Kutayia was signed on May 14, 1833, by which the sultan agreed to bestow on Mehemet Ali the pashaliks of Syria, Damascus, Aleppo and Itchell, together with the district of Adana.

Mehemet Ali now ruled over a virtually independent empire, subject only to a moderate tribute, stretching from the Sudan to the Taurus mountains. But in the spring of 1839, the sultan ordered his army, concentrated under Reshid in the border district of Bir on the Euphrates, to advance over the Syrian frontier. Ibrahim, seeing his flank menaced, attacked it at Nezib on June 24. Once more the Ottomans were utterly routed. Six days later, before the news reached Constantinople, Mahmud died. Once more the Ottoman empire lay at the feet of Mehemet Ali; but the Powers were now more prepared to meet a contingency which had been long foreseen. Their intervention was prompt; and the end was reached early in 1841. New firmans were issued which confined the pasha's authority to Egypt, the Sinai peninsula and certain places on the Arabian side of the Red sea, and to the Sudan. The most important of these documents are dated Feb. 13, 1841. The government of the pashalik of Egypt was made hereditary in the family of Mehemet Ali. (This provision has been observed. The successors of Mehemet Ali have been (1) Ibrahim, his eldest son; (2) Abbas, his grandson; (3) Said, his fourth son; (4) Ismail, son of Ibrahim; (5) Tewfik, eldest son of Ismail; (6) Abbas Hilmi, son of Tewfik; (7) Hasain Kāmil, second son of Ismail; and (8) Fuād, a younger son of Ismail.) Various restrictions were laid upon Mehemet Ali, emphasizing his position of vassalage. He was forbidden to maintain a fleet, and his army was not to exceed 18,000 men. The pasha was no longer a figure in European politics, but he continued to occupy himself with his improvements, real or imaginary, in Egypt. The condition of the country was deplorable; in 1842 a murrain of cattle was followed by a destructive Nile flood; in 1843 there was a plague of locusts, whole villages were depopulated. Meantime the uttermost farthing was wrung from the wretched fellahin, while they were forced to the building of magnificent public works by unpaid labour. In 1847 Mehemet Ali laid the foundation stone of the great barrage across the Nile at the beginning of the Delta. He was barely dissuaded from ordering the barrage to be built with stone from the pyramids. Towards the end of 1847 the aged pasha's mind began to give way, and by the following June he was no longer capable of administering the Government. In Sept. 1848 Ibrahim was acknowledged by the Porte as ruler of the pashalik, but he died in the November following. Mehemet Ali survived another eight months, dying on Aug. 2, 1849, aged 80. He had done great things in Egypt; the most permanent being the weakening of the tie binding the country to Turkey, the starting of the great cotton industry, the recognition of the advantages of European science, and the conquest of the Sudan. (F. R. C.; ME.)

Abbas I. and Said Pasha.—On Ibrahim's death in Nov. 1848 the government of Egypt fell to his nephew, Abbas I., the son of Tusun. Abbas put an end to the system of commercial monopolies, and during his reign the railway from Alexandria to Cairo was begun at the instigation of the British Government. Opposed to European ways, Abbas lived in great seclusion, and after a reign of less than six years he was murdered (July 1854) by two of his slaves. He was succeeded by his uncle, Said Pasha, the favourite son of Mehemet Ali, but a weakling. In his reign a land law of 1858 secured to the fellahin an acknowledgment of freehold as against the Crown. The pasha was much under French influence, and in 1856 was induced to grant to Ferdinand de Lesseps a concession for the construction of the Suez canal. Lord Palmerston was opposed to this project, and the British opposition delayed the ratification of the c by the Porte for two years. To the British Said also made to the Tele- [illegible] company, and another (1854) allowing the t of the Bank of Egypt. He also began the national debt by borrowing £3,293,000 from Messrs. Frühling and Göschen, the actual amount received by the pasha being £2,640,000. In Jan. 1863 Said Pasha died and was succeeded by his nephew, Ismail, a son of Ibrahim Pasha.

Reign of Ismail.—The reign of Ismail from 1863 to 1879 was for a while hailed as introducing a new era into modern Egypt. In spite of his vast schemes of reform and the *éclat* of his Europeanizing innovations, his oriental extravagance led to bankruptcy and European intervention in the internal affairs of Egypt. Yet in its earlier years much was done which seemed likely to give Ismail a more important place in history. In 1866 he received from the sultan (in consideration of his tribute being doubled) the right of primogeniture for his family: in 1867 the title of *khedive;* and in 1873 the recognition of virtually independent sovereignty. He re-established and improved the administrative system organized by Mehemet Ali, which had fallen into decay under Abbas's indolent rule; he caused a thorough remodelling of the customs system, which was in an anarchic state, to be made by English officials; in 1865 he established the Egyptian post office; he reorganized the military schools of his grandfather, and gave some support to the cause of education. Railways, telegraphs lighthouses, the harbour works at Suez, the breakwater at Alexandria, were carried out by some of the best contractors of Europe. Most important of all, the Suez canal was opened in 1869. But the funds required for these public works, as well as the actual labour, were remorselessly extorted from a poverty stricken population. At the same time thousands of lives were lost and large sums expended in extending Ismail's dominions in the Sudan and in futile conflicts with Abyssinia. In 1875 the impoverishment of the fellah had reached such a point that the ordinary resources of the country no longer sufficed for the most urgent necessities of administration; and the khedive Ismail, having repeatedly broken faith with his creditors, could not raise any more loans on the European market. The taxes were habitually collected many months in advance, and the colossal floating debt was increasing rapidly. In these circumstances Ismail had to realize his remaining assets, and among them sold 176,602 Suez Canal shares to the British Government for £3,976,582.

The crisis had come, and a series of international enquiries were now forced upon Ismail, each of which brought him more under European control. The establishment of the Mixed Tribunals in 1876, in place of the system of consular jurisdiction in civil actions, made some of the courts of justice international. The Caisse de la Dette, instituted in May 1876 as a result of a British financial mission (Stephen Cave and Sir John Stokes) which had been at work in the previous year, led to international control over a large portion of the revenue. Next came (in Nov. 1876) the mission of Mr. (afterwards Lord) Goschen and M. Joubert on behalf of the British and French bondholders, one result being the establishment of dual control, *i.e.*, an English official to superintend the revenue and a French official the expenditure of the country. Another result was the internationalization of the railways and the port of Alexandria. Another commission of enquiry, of which the principal members were Sir Rivers Wilson, Maj. Evelyn Baring (afterwards Lord Cromer) and MM. Kremer-Baravelli and de Blignières, extended international control to the enormous landed property of the khedive. Driven to desperation, Ismail made a virtue of necessity and accepted, in Sept. 1878, in lieu of the dual control, a constitutional ministry, under the presidency of Nubar Pasha, with Rivers Wilson as minister of finance and de Blignières as minister of public works. Before seven months had passed he found his constitutional position intolerable, got rid of his irksome cabinet by means of a secretly-organized military riot in Cairo, and reverted to his old autocratic methods of government. England and France appealed to the suzerain power, which was delighted to have an opportunity of asserting its authority. On June 26, 1879, Ismail suddenly received from the sultan a curt telegram, addressed to him as ex-khedive of Egypt, informing him that his son Tewfik was appointed his suc r. Taken unawares he made no attempt at ce and Tewfik was at once pro-

Events Leading to British Occupation.—After a short period of inaction, England and France, in Nov. 1879, re-established the dual control in the persons of Maj. Baring and M. de Blignières. For two years it governed Egypt, and initiated the work of progress that England was to continue alone. Of necessity it antagonized the classes which had long misgoverned the country for their own benefit. A movement of revolt slowly matured, largely military in its origin. Among its leaders was a fellah officer calling himself Ahmed Arabi the Egyptian. He was not a man of exceptional intelligence but solid and direct, influencing the masses by a rude kind of native eloquence. Behind him were a group of men, much abler than himself, who put him forward as the figurehead of a party professing to aim at protecting the Egyptians from the grasping tyranny of their Turkish and European oppressors. The Government, being too weak to suppress the agitation and disorder, had to make concessions, and each concession produced fresh demands. Arabi was first promoted, then made under-secretary for war, and ultimately a member of the cabinet. The danger of a serious rising brought the British and French fleets in May 1882 to Alexandria, and after a massacre (June 11) had been perpetrated by the Arab mob in that city, the British admiral bombarded the forts (July 11, 1882). The leaders of the national movement prepared to resist further aggression by force; and the sultan refused an invitation to suppress them.

At last the British Government determined to employ armed force, and invited France to co-operate. The French Government declined, and a similar invitation to Italy met with a similar refusal. England, therefore, having to act alone, landed troops at Ismailia under Sir Garnet Wolseley, who defeated Arabi in the battle of Tell-el-Kebir on Sept. 13, 1882. The khedive, who had taken refuge in Alexandria, returned to Cairo, and a ministry was formed under Sherif Pasha. Arabi was tried, and by arrangement pleaded guilty and was banished. The lives of his colleagues were also spared. This solution of the difficulty was brought about by Lord Dufferin, then British ambassador at Constantinople, who had been sent to Egypt as high commissioner to adjust affairs and report on the situation. One of his first acts, after preventing the application of capital punishment to the ring-leaders of the revolt, was to veto the project of protecting the khedive and his government by means of a Praetorian guard recruited from Asia Minor, Epirus, Austria and Switzerland, and to insist on the principle that Egypt must be governed in a truly liberal spirit. Passing in review all the departments of the administration, he laid down the general lines on which the country was to be restored to order and prosperity, and endowed, if possible, with the elements of self-government for future use.

Sir Evelyn Baring, Consul-general, 1884.—The laborious task of putting these general indications into a practical shape fell to Sir Evelyn Baring (Lord Cromer), who arrived as consul-general and diplomatic agent, in succession to Sir Edward Malet, in Jan. 1884. The position with which he was confronted was that, for the third time in little more than three years, the existing authority had been destroyed and a new one had to be created. But the power that had now to reorganize the country possessed in the British army of occupation a support sufficient to command respect. Without that support Sir Evelyn Baring could have done little or nothing; with it he did perhaps more than any other single man could have done. His difficulties arose in England as well as in Egypt. At first the aim of the British Government was to restore the power of the khedive, to keep him for some time in the right path by friendly advice, and to withdraw the British troops as soon as possible. As Lord Granville explained in a circular to the Powers, the position of England in Egypt imposed on her "the duty of giving advice with the object of securing that the order of things to be established shall be of a satisfactory character and possess the elements of stability and progress." But there was to be no embarking on a general scheme of reforms, which would increase unnecessarily the responsibilities of the protecting power and necessitate the indefinite prolongation of the military occupation. So far, therefore, as the British Government had a definite policy in Egypt, it was a *politique de expédient*. Even this policy was not strictly adhered to. Mr Gladstone's cabinet had its hot fits and its cold fits, and it gave orders now to advance and now to retreat. In the long run circumstances proved too strong for it, and it had to undertake a great deal more than it originally intended. And all the while its agents in Egypt were faced by a growing volume of nationalist feeling, for which neither guidance nor safety valves were provided.

Of the numerous questions awaiting solution, the first to claim immediate attention was that of the Sudan. The British Government had begun by excluding it from the problem; but it was an integral part of the khedive's dominions, and caused, even in ordinary times, a deficit of £200,000 to the Egyptian treasury. At that moment it was in a state of open rebellion, stirred up by a religious fanatic who proclaimed himself a mahdi of Islam. An army of 10,000 men under an English officer, Col. William Hicks, otherwise Hicks Pasha, had been sent to suppress the revolt, and had been annihilated in a great battle fought on Nov. 5, 1883, near Obeid. The Egyptian Government wished to make a new attempt to recover the lost province, and the idea was certainly very popular among the governing class, but Sir Evelyn Baring vetoed the project on the ground that Egypt had neither soldiers nor money to carry it out. The efforts made to extricate the scattered garrisons surrounded by the Mahdi's forces, the mission of Gen. Gordon, the fall of Khartoum, and the Nile expedition under Lord Wolseley, are described separately. The practical result was that the khedive's authority was limited to the Nile valley north of Wadi Halfa.

Internal Reorganization.—With the internal difficulties Sir Evelyn Baring had been struggling bravely ever since his appointment. For two or three years it seemed doubtful whether he would succeed. All over Egypt there was a feeling of unrest. The introduction of English officials and English influence into all the administrative departments was resented by the native officials, and the action of the irrigation officers in preventing the customary abuses of the distribution of water was resented by the great landowners. Even the fellahin, who gained most by the reforms, were discontented, for the defeat of Arabi and the re-establishment of order had enabled the Christian money-lenders to return and insist on the payment of claims, which were supposed to have been extinguished by the rebellion. Worst of all, the Government was drifting rapidly towards insolvency; all departments were being starved, and even the salaries of poorly paid officials were in arrear. To free itself from its financial difficulties the Government adopted a heroic remedy by diverting into the Treasury certain revenues which should have been paid into the Caisse de la Dette for the benefit of the bondholders. Immediately the Powers protested against this infraction of the law of liquidation, and the Caisse applied for a writ to the Mixed Tribunals. The heroic remedy failed; but ultimately the British Government succeeded in negotiating the London Convention of March 1885, by which the Egyptian Government was enabled to raise a loan of £9,000,000 for an annual payment of £315,000. After paying out of the capital the sums required for the indemnities due for the burning of Alexandria and the deficits of the years 1882 and 1883, it still had a million sterling, and boldly invested it in the improvement of irrigation. The investment proved most remunerative, and helped very materially to save the country from bankruptcy. The danger of being again subjected to the evils of an international administration was very great, for the London Convention contained a stipulation to the effect that if Egypt could not pay her way at the end of two years, another international commission would be appointed.

To obviate this catastrophe the British reformers set to work most energetically. Already something in the way of retrenchment and reform had been accomplished. The public accounts had been put in order, and the abuses in the collection of the land tax removed. The constant drain of money and men for the Sudan had been stopped. A beginning had been made for creating a new army to replace the one that had been disbanded and to allow of a portion of the British garrison being withdrawn. In this work Sir Evelyn Wood had shown much sound judgment as well as great capacity for military organization, and had formed an efficient force out of very unpromising material. His colleague

[illegible] Colin Scott Moncrieff [illegible] the irrigation system, on which the prosperity of the country mainly depends, he had conferred enormous benefits on the fellahin, and had laid the foundation of permanent budgetary equilibrium for the future. Not less active was Sir Edgar Vincent, the financial adviser, who kept a firm hold on the purse-strings and ruthlessly cut down expenditure in all departments except that of irrigation. All this reforming activity engendered a certain amount of discontent and resistance; but the attitude of the British Government was thus defined by Lord Granville.

"It should be made clear to the Egyptian ministers and governors of provinces that the responsibility which for the time rests on England obliges H.M. Government to insist on the adoption of the policy which they recommend; and that it will be necessary that those ministers and governors who do not follow this course should cease to hold their offices."

There was not yet, however, any correlative movement towards the working principle which was officially formulated at a much later period: "Our task is not to rule the Egyptians, but as far as possible to teach the Egyptians to rule themselves. . . . European initiative suggests measures to be executed by Egyptian agency, while European supervision controls the manner in which they are executed." If that principle had been firmly laid down and clearly understood at the beginning, a good deal of needless friction would have been avoided.

International Problems.—The international difficulty remained. The British position in Egypt was anomalous, and might easily give rise to international complications. The sultan might well protest against the military occupation of a portion of his empire by foreign troops. It was no secret that France was ready to give him diplomatic support, and other Powers might adopt a similar attitude. Besides this, the British Government was anxious to terminate the occupation as soon as possible. With a view to regularizing the situation and accelerating the evacuation, Sir Henry Drummond Wolff was sent to Constantinople in Aug. 1885 on a special mission. On Oct. 24 of that year he concluded a preliminary convention by which an Ottoman and a British high commissioner, acting in concert with the khedive, should reorganize the Egyptian army, tranquillize the Sudan by pacific means, and consider what changes might be necessary in the civil administration. When the two commissioners were assured of the security of the frontier and the good working and stability of the Egyptian Government, they should present reports to their respective Governments, and these should consult as to the conclusion of a convention regulating the withdrawal of the English troops. In 1887 this was followed by a definitive convention, according to which the occupation should come to an end in three years, but England should have a right to prolong or renew it in the event of internal peace or external security being seriously threatened. The sultan authorized the signature of this convention, but under pressure of France and Russia he refused to ratify it.

The steadily increasing prosperity of the country during the years 1886 and 1887 removed the danger of national bankruptcy and international interference, and induced Sir Evelyn Baring to widen the area of administrative reforms. The new Egyptian army was so far improved that it gained successes over the forces of the Mahdi; the burden of the national debt was lightened by a successful conversion; the *corvée* was abolished (except in so far as it was necessary to call out men to guard the banks of the Nile in the season of high flood); the land tax was reduced 30% in the [illegible] and other measures for [illegible] tary surplus constantly [illegible] roved, and John Scott, [illegible] sound judgment, was [illegible]. The very necessary [illegible] taken seriously in hand. [illegible] accelerated: the work [illegible] by a carefully [illegible]

the reforming activity was extended to prisons, public health, and education, and attained very satisfactory results.

Accession of Abbas.—In Jan. 1892 the khedive Tewfik, who had always maintained cordial relations with Sir Evelyn Baring, died suddenly, and was succeeded by his son, Abbas Hilmi, a young man without political experience. Aspiring to liberate himself at once from foreign control, he summarily dismissed the prime minister, Mustafa Pasha Fehmi (Jan. 15, 1893), whom he considered too amenable to English influence, and appointed in his place Fakhri Pasha, who was not a *persona grata* at the British Agency. This led to remonstrances and a compromise; but the young khedive long clung to his idea of liberating himself from all control, and secretly encouraged a Nationalist and anti-British agitation in the native press. Relations, however, between the British officials and their Egyptian colleagues gradually became more cordial, so that it was found possible at last to reform the local administration in the provinces according to the recommendations of Eldon Gorst, who had been appointed adviser to the ministry of the interior. Mustafa Fehmi was reinstated as prime minister at the end of 1895, and thereafter the Anglo-Egyptian condominium worked without serious friction.

Fashoda.—The success of the Anglo-Egyptian condominium, and the consequent economic and financial prosperity of Egypt proper, rendered it possible, during 1896–98, to recover from the Mahdists the Sudanese provinces and to delimit in that part of Africa, in accordance with Anglo-Egyptian interests, the respective spheres of influence of Great Britain and France. The arrangement was not effected without serious danger of a European conflict. French policy had aimed at an establishment in the upper Nile valley, which would link up the French possessions in West Africa with those at the entrance to the Red sea. With this object a small force under Maj. Marchand was sent from the French Congo into the Bahr-el-Ghazal; whilst a Franco-Abyssinian expedition was despatched from the eastward, to join hands with Maj. Marchand. The small force from the French Congo reached Fashoda on the Nile; but General (afterward Lord) Kitchener hastened up the river with a stronger Anglo-Egyptian escort, and persuaded Marchand to evacuate Fashoda and to retire by the Abyssinian route. By an agreement signed by Lord Salisbury and the French ambassador on March 21, 1899, France abandoned the basin of the Nile, and a line marking the respective spheres of influence of the two countries was drawn on the map from the northern frontier of the Congo Free State to the southern frontier of the Turkish province of Tripoli.

The administration of the Sudan was organized on the basis of an agreement between the British and Egyptian Governments signed on Jan. 19, 1899. According to that agreement the British and Egyptian flags were used together and the supreme military and civil command is vested in a governor-general, who is appointed by the khedive on the recommendation of the British Government, and who cannot be removed without the British Government's consent. Neither consular jurisdiction, nor that of the mixed tribunals, was permitted, the Sudan being made absolutely free of the international fetters which bound Egypt. Sir Reginald Wingate, the sirdar of the Egyptian army (in which post he succeeded Lord Kitchener at the close of 1899) was named governor-general, and in the work of regeneration of the country, the officials, British, Egyptian and Sudanese, had the cordial co-operation of the majority of the inhabitants.

Egypt in the 20th Century.—The growing prosperity of Egypt in the opening years of the 20th century was very marked, and is reflected in the annual reports on the country supplied to the British Foreign Office by Lord Cromer. Thus, in 1901 he was able to declare that "the foundations on which the well-being and material prosperity of a civilized community should rest have been laid. . . . The institution of slavery is virtually defunct. The *corvée* has been practically abolished. Law and order everywhere reign supreme. The *curbash* is no longer employed as an [illegible] t of [illegible] ment." So little danger to internal peace was [illegible] that during this year Arabi Pasha, who had been [illegible]

anomalies worked smoothly. Land increased in value as irrigation schemes were completed and European capital was increasingly eager to find employment in the country. The bulk of the fellahin enjoyed a material prosperity to which they had been strangers for centuries.

The facilities enjoyed by the British and Egyptian Governments for securing the material development of Egypt were greatly enlarged in 1904, as the result of the understanding then come to between France and Great Britain. The natural irritation in France arising from the British occupation of the Nile valley, and the non-fulfilment of the pledge to withdraw the British garrison from Egypt, which had grown less acute with the passing of years, flamed out afresh at the time of the Fashoda crisis; but during 1903 a great change came over public opinion on both sides of the Channel, and a settlement was reached of many points in dispute between the two nations. On April 8, 1904, a declaration was signed by the representatives of France and Great Britain which virtually recognized the dominant position of France in Morocco and of Britain in Egypt.

Similar declarations and engagements were made by Germany, Austria and Italy. Annexed to the Anglo-French agreement was the text of a khedivial decree which, with the consent of the Powers came into operation on Jan. 1, 1905. The declaration was in effect a European recognition that Britain was the protecting power in Egypt. It put a period to a question which had long embittered the relations between England and France, and locally it caused the cessation of the systematic opposition of the French agents in Cairo to the British administration. Scarcely less important were the results of the khedivial decree. By it Egypt achieved in effect financial independence. The power of the Caisse de la Dette, which had virtually controlled the execution of the international agreements concerning the finances, was swept away, together with almost all the other financial fetters binding Egypt. For the first time since 1875 Egypt was free to control her own revenue. In return she pledged the greater part of the land tax to the service of the debt, and the functions of the Caisse were restricted to the receipt of the funds necessary for this service. Moreover, some £10,000,000, being accumulated surpluses in the hands of the Caisse after meeting the charges of the debt, were handed over to the Egyptian Treasury. The Egyptian Government was henceforth free to take full advantage of the financial prosperity of the country. In one respect only were the new arrangements open to criticism: they left untouched the extra-territoriality in criminal cases enjoyed by Europeans in Egypt in virtue of the treaties with Turkey, *i.e.*, the system of capitulations. Associated with the capitulations régime was the absence of any proper machinery for enacting laws applicable to the whole of the inhabitants of Egypt. No change could be made in any law applicable to Europeans without the unanimous consent of 15 foreign Powers—a state of affairs wholly incompatible with the condition of Egypt in the 20th century, "an oriental country which has assimilated a very considerable portion of European civilization and which is mainly governed by European methods."

Unrest and Denshawai.—While the removal of ancient jealousies among the European powers interested in Egypt helped to smooth the path pursued by the Egyptian administration under the guiding hand of Great Britain, the intrigues of the Turks and a revival of Muslim religious fervour threatened during 1905–06 to disturb the peace of the country. The Nationalist party, now under the leadership of Mustafa Kamil (1874–1908), was alive to the value of any weapon in its claim that Egypt was now ripe for self-government. The Nationalist press burst into an orgy of inflammatory writing, encouraged by many persons holding high positions both inside and outside Egypt, and created, by every process of misrepresentation, an anti-Christian and anti-European feeling among the mass of the people. After more than a quarter of a century, *i.e.*, since the accession of Tewfik, the tyranny of the Turkish system was apt to be forgotten, while the appeal to rally in support of their khalif found a response in the hearts of many Egyptians. The tension was increased, even if resentment was silenced, by the Denshawai incident in June 1906, when an affray between villagers and a few British officers was followed by judicial retribution of a severity which long rankled in the minds even of the fellahin.

The Taba Incident.—It was at this juncture that the Taba incident arose over the claim of the sultan of Turkey to jurisdiction in the Sinai peninsula. Mehemet Ali and his successors up to and including Tewfik had administered the Sinai peninsula and certain posts on the Arabian side of the Gulf of Akaba. The firman of investiture issued by the sultan on the occasion of the succession of Abbas Hilmi in 1892 differed, however, from the text of former firmans, and had to be rectified by a telegram (dated April 8, 1892) from the grand vizier, in which it was declared that the *status quo* was maintained in the Sinai peninsula. As officially stated by the British Government at the time, the eastern frontier of the Sinai peninsula was taken to be a line running in a south-easterly direction from Rafa, a place on the Mediterranean, east of El Arish, to the head of the Gulf of Akaba. So matters rested until, in 1905, in consequence of lawlessness among the Bedouins of the peninsula, a British official was appointed commandant and inspector of the peninsula and certain administrative measures taken. The report was spread by pan-Islamic agents that the intention of the Egyptian Government was to construct fortifications on the frontier near Akaba, to menace the railway which the Turks were building from Damascus to Mecca. In Jan. 1906 the sultan complained to the British ambassador at Constantinople of Egyptian encroachments on Turkish territory, and the local Turkish commandant seized Taba, a port near Akaba but on the western side of the gulf. A period of considerable tension ensued, and at a conference held between the khedive and Mukhtar Pasha, the Ottoman commissioner, the latter claimed that the peninsula of Sinai consisted only of the territory south of a straight line from Akaba to Suez. In other words the claim of the Porte was, to quote Lord Cromer: "to carry the Turkish frontier and strategical railways to Suez on the banks of the canal; or that if the Ras Mahommed line were adopted, the Turkish frontier would be advanced to the neighbourhood of Nekhl, *i.e.*, within easy striking distance of Egypt, and that . . . the Gulf of Akaba . . . would practically become a *mare clausum* in the possession of Turkey and a standing menace to the security of the trade route to the East."

Such proposals could not be entertained by Great Britain; and it was only after a virtual ultimatum that the sultan gave way and agreed (on May 14) that the line of demarcation should start at Rafa and run towards the south-east "in an approximately straight line as far as a point on the Gulf of Akaba at least 3 m. distant from Akaba." The Turkish troops were withdrawn from Taba, and the delimitation of the frontier was undertaken by a joint Turco-Egyptian commission. An agreement was signed on Oct. 1 finally settling the frontier line.

In April 1907, a few days after the appearance of his report for 1906, in which the "Nationalist" and pan-Islamic movements were declared to be detrimental to the welfare of Egypt, Lord Cromer resigned his post of British agent and consul-general. His resignation, dictated by reasons of health, was described by Sir Edward Grey as "the greatest personal loss which the public service of this country (Britain) could suffer." He left the country in a state of unexampled material prosperity, free from the majority of the international fetters with which it was bound when he took up his task in 1883, and with the legitimate expectation that the work he had done would endure. Lord Cromer was succeeded by Sir Eldon Gorst, who had served in Egypt 18 years under him, and was at the time of his appointment to Cairo an assistant under-secretary of State for foreign affairs.

(X.; ME)

New Policy Under Gorst.—It fell to the lot of Gorst to carry out the policy of the new Liberal Government in England—a policy suggested by Cromer originally—of giving the Egyptian authorities a wide freedom in administration. A measure for increasing the powers of the provincial councils was promulgated in June 1908. The Denshawai prisoners had been released in the preceding January, and Mustapha Kamil's death in February had been followed by schisms in the Nationalist camp. Nevertheless the Nationalist movement made active headway. The legislative com-

[illegible] were demanding [illegible] government [illegible] the establishment [illegible] Turkey in the summer of 1908. The instalment of political freedom which Gorst had secured was regarded as negligible; and the internal dissensions of the Nationalists tended to disappear in a common anti-British front. In Nov. 1908 Mustapha Fehmi resigned on the ground of ill-health, and with him there went his powerful and sustained influence in favour of co-operation with the British. The selection as his successor of Boutros Pasha, a Copt, aroused Muslim hostility; and the extreme section of the Nationalist party, secretly backed by the khedive, was effectively overpowering the moderate wing. In the assembly it soon proved its domination by rejecting (Feb. 1910) a measure for the extension of the Suez Canal company's concession. Two days later, the prime minister, who had introduced the measure, was assassinated by a young Nationalist fanatic. His place was taken by Mohammed Saïd Pasha, a protégé of the khedive; but the general assembly was not convoked again, and drastic measures were necessary to check anti-British demonstrations. In the last report which he lived to submit, Gorst deplored the failure of the programme of 1907, and warned the British Government that "the policy of ruling Egypt in co-operation with native ministers was incompatible with that of encouraging the development of so-called representative institutions." In July 1911 he surrendered his office, and died within a month.

Régime of Lord Kitchener.—Lord Kitchener arrived as occupant of the residency in Sept. 1911. His first pre-occupation was to impose order in the country, and to deal with the difficult situation created by the Italian declaration of war on Turkey and landing in Tripolitania. The excesses of nationalist extremism were repressed, and the use of Egypt or Egyptian forces against Italy by their nominal suzerain, the sultan, was quietly prevented. Islamic sentiment was none the less on edge, and early in 1912 a plot was discovered to kill the khedive, the prime minister and Lord Kitchener. Meanwhile a programme of administrative reform and constitutional progress was actively pursued. The peasantry were given a measure of protection from the money-lender, and the reform of the Waqf department, which was supposed to hold a wealth of Muslim pious foundations in trust, was undertaken. A new organic law of 1913 replaced the earlier statute of 1883, and a single legislative assembly was constituted in lieu of the two former bodies. It was composed of 66 members elected by indirect suffrage, and of 17 members nominated by the Government to represent minorities and interests which would otherwise have had no voice. It remained a consultative and deliberative body, although it had power to veto any increase in direct taxation; but it could delay legislation, record opinions on administrative business, and initiate measures of its own. The president and one vice-president were appointed by the Government. For the second vice-president the choice of the assembly fell on Saad Zaghlul Pasha, formerly minister of education and now the acknowledged leader of the nationalists. The whole scheme was distasteful to the khedive, and a palace intrigue led to the fall of Mohammed Saïd. He was succeeded by Hasain Rushdi Pasha, who remained in office until the end of 1918. The new assembly began its career by a session of fruitless bickering, and the hostility of the khedive became so undisguised that by 1914 Lord Kitchener would seem to have come to the conclusion that he must be either muzzled or removed.

The Protectorate.—When the World War broke out, Lord Kitchener was on leave in England, and the khedive was on a visit to Constantinople. The former became secretary of State for war, and never returned to Egypt. The latter was frankly involved with the enemies of England, and he, too, came back no more. The Egyptian Government immediately on the declaration of war, threw in its lot with the Allies. The legislative assembly was suspended and did not meet again. Ministers took action against German ships in Egyptian ports, and by the proclamation of martial law on Nov. 2 it became possible both to enforce administrative measures without reference to the assembly, and to take action affecting foreign subjects without first obtaining the assent of the Powers. The entry of Turkey into the war rendered the juridical position of Egypt, from the British point of view, an impossible anomaly; and accordingly a proclamation was issued on Dec. 18, 1914, by the British Foreign Office, with the following announcement:

"In view of the state of war arising out of the action of Turkey Egypt is placed under the protection of His Majesty and will henceforth constitute a British protectorate. The suzerainty of Turkey over Egypt is thus terminated and His Majesty's Government will adopt all measures necessary for the defence of Egypt and protect its inhabitants and interests."

A further proclamation issued the following day announced that the khedive, Abbas Hilmi, who was in Constantinople, was deposed on the grounds of adherence to the King's enemies, and that his uncle, Prince Husein Kamel, had accepted the succession and would bear the title of sultan of Egypt. The new status was introduced without disturbance if without enthusiasm, and the new high commissioner, Sir Henry McMahon, took over the control of Egyptian foreign affairs. After the abortive Turkish attack on the Suez canal, the prestige of the sultan increased, but the failure in the Dardanelles produced some reaction and in 1915 his life was twice attempted. The Egyptian people, however, bore with patience the disabilities and unwelcome requisitions which the war entailed, and thus laid Great Britain under obligations, both moral and financial, for which too little credit was given.

On the other hand the withdrawal of British officials for service elsewhere opened a wider field for Nationalist propaganda, which found ready listeners among the younger men who had not known the pre-occupation conditions. A dissatisfied civil service regarded the growing number of British officials as a bar to promotion and the Nationalist ranks were reinforced by the students, whose prospect of obtaining State employment was diminished by foreign competition. A professed intention to train Egyptians to manage their own affairs seemed inconsistent with the constant increase of British officials, and their steady encroachment on administrative functions. Moreover, as their number grew, they became a separate community living aloof from Egyptians, and with loss of contact their moral influence diminished.

Succession of King Fuad.—At the end of 1916 Gen. Sir Reginald Wingate, sirdar and governor-general of the Sudan since Dec. 1899, replaced Sir H. McMahon as high commissioner. The declining health of Sultan Husein made a settlement of the succession urgent. His only son, Prince Kemal-ed-Din, declined the position of heir-apparent, which was then offered to the sixth son of Ismail, Prince Fuad, who had been educated at the military school at Turin. Sultan Husein died in Oct. 1917. The principles formulated by the President of the United States towards the close of the World War had a far-reaching effect on educated opinion in Egypt. Numerous disclaimers by British statesmen of any intention to occupy the country permanently were insistently recalled, and the acceptance of the principle of self-determination was represented as having given international sanction to the aspirations of Egyptians to govern themselves. When, in Nov. 1918, an Anglo-French declaration announced that the Allies contemplated the enfranchisement of the peoples oppressed by Turkish rule, Egyptians regarded their title to manage their own affairs to be even stronger than that of Syria, Mesopotamia or of Arabia, where an independent kingdom had already been established. No sooner was the Armistice signed than Zaghlul, as the head of a strong Nationalist committee, asked permission to go to London and submit Egypt's case for independence. The British Foreign Office rejected the proposal; and the reception in London of Egyptian Ministers though earnestly supported by Sir R. Wingate, was dismissed as equally impossible. Ministers thereupon resigned; Sir R. Wingate was summoned to London to make a personal report, and there was a steady drift of moderates into the nationalist camp. A *Wafd* or Nationalist delegation to proceed to London and Paris, was constituted on a Democratic basis. The prime minister resigned in final protest against his country being unrepresented at the Peace Conference; and the Wafd movement became so serious that martial law was invoked and Zaghlul and three of his most important adherents were arrested on March 8 1919 and

deported to Malta

Outbreak of March 1919 The immediate effects of the measure revealed the gravity of the internal situation in Egypt. Anti-British demonstrations in Cairo necessitated military intervention. There were disturbances at Tanta and in the Delta provinces where British soldiers and civilians were attacked. Railway lines were torn up, telegraph wires cut and by the middle of March, Cairo was isolated. Foreign colonies were blockaded in Upper Egypt, and at Dairut station a British inspector of prisons, two officers and five other ranks were brutally murdered in the train by a fanatical crowd. Mobile columns were rapidly despatched to disturbed areas, communications were re-established and before the end of March the situation was well in hand. The Egyptian police behaved throughout in an exemplary manner. The Egyptian army which, all but a few units, was in the Sudan, remained unaffected. With these exceptions the agitation was supported by every class, including the Copts whose solidarity with the Muslim was no doubt prompted by prudential considerations. If the movement was only partial among the peaceful unchanging fellaheen it was nevertheless perceptible that their experiences during the war had stirred a spirit of discontent even in the class which had benefited most from the British occupation. Recruiting for the Labour and Camel Corps had not been unpopular in the earlier volunteer stage. But when voluntary enlistment ceased to produce a sufficient number of men some administrative compulsion was exercised by unscrupulous mudirs, who, alleging British insistence, accepted bribes for exemptions and sent their enemies to serve. The requisition of domestic animals and of cereals had pressed hardly on the small farmer and had provided local officials with many an opportunity for abuses. The cost of food, clothing and fuel rose in an unprecedented manner and the average wages of the labouring class did not expand correspondingly. Meanwhile the producer of cotton and the privileged foreigner were notoriously accumulating fortunes

When the outbreak became serious, Lord Allenby, the commander-in-chief in Egypt, who had left for Paris, was directed to return at once as special high commissioner during the absence of Sir R. Wingate. After the restoration of law and order a phase of passive resistance succeeded that of aggression. Lord Allenby, however, adopted a policy of conciliation, and a removal of the embargo on the free movement of Egyptians entailed the liberation (April 1919) of Zaghlul and his associates. They left Malta for Paris, where their hopes to obtain a hearing at the peace conference were disappointed; and the local unrest continued.

The Milner Mission.—The British Government now decided to send a mission to Egypt under the chairmanship of Lord Milner, "to enquire into the causes of the recent disorders, and to report on the existing situation in the country and the form of the Constitution which, under the protectorate will be best calculated to promote its peace and prosperity, the progressive development of self-governing institutions and the protection of foreign interests." It would have been well if the mission could have proceeded at once before the Nationalists had completed an organization which was now receiving encouragement from sections of the Arab university of El Azhar. But circumstances rendered its departure before the autumn difficult and arrangements for boycotting it were leisurely elaborated. In Dec. 1919 it reached Cairo, and special measures for the protection of its members had to be taken in view of an organized antagonism, in which even the Cairene ladies took a demonstrative part. Pickets of students watched their hotel, and individual members were followed into the provinces. A visit to Tanta provoked riots in that city. During the residence of the mission in Cairo, there were repeated assaults on British soldiers and no less than three attempts to assassinate Egyptian ministers with bombs. The chiefs of El Azhar now openly identified themselves with the Nationalists in a manifesto addressed to the high commissioner. Innumerable letters and resolutions were received denouncing the protectorate.

A declaration issued on Dec. 29, in which the real objects of the mission were clearly stated, had some reassuring influence. But the general boycott was rigidly maintained and relations with Egyptians were restricted to informal discussions with individuals no had the courage to be independent. As time went on, however, such conversations became general and the mission found no difficulty in estimating the current feeling in the country. The working of every department was thoroughly investigated, and before the departure of the mission, in March 1920, a large volume of material had been assembled, and certain proposals, unanimously adopted, were provisionally drafted pending the preparation of a final report in England.

Negotiations with Zaghlul.—Shortly after its return occasion was taken, through the good offices of Adly Pasha, to enter into relations with the Egyptian delegation then established in Paris, which, it could no longer be doubted, represented a majority of Egyptian opinion. Zaghlul, with seven other delegates, came to London in June; and after deliberations extending till the middle of August, in which Adly also took an unofficial conciliatory part, a memorandum which came to be known as the Milner-Zaghlul agreement, was drafted. It adopted the basis of settlement proposed by the special mission, a treaty of alliance in which Egypt contracted definite obligations in return for the recognition of independence, with certain additions such as the acceptance in principle of the rights of Egypt to foreign representation. Any reference to the Sudan was specifically excluded. As Zaghlul and his colleagues were not prepared to commit themselves to definite agreement without consulting their supporters, four members of the delegation proceeded to Cairo. On the return of the latter (Oct. 1920) they reported that the proposed settlement had been well received. At the same time they had been urged to invite modifications of certain points, including a restriction of the functions of the financial adviser and the official attached to the Ministry of Justice. Zaghlul insisted that his efforts to promote a settlement might be compromised if he could give no undertaking regarding the abolition of the protectorate. The delegates then left England and the mission sent in its report on Dec. 29, 1920. The inability of the British Government to act promptly on its recommendations has been the tragedy of Egypt's later history.

At the beginning of 1921 Adly Pasha had a strong following in Egypt and Zaghlul's influence appeared to be diminishing. On the other hand the resignation of Lord Milner was regarded as an indication that the British Government might not endorse the recommendations of the mission, while a reference in a speech from the new colonial secretary (Lord Curzon) to Egypt as included in the elastic circle of the British empire, evoked a number of protesting telegrams. When, however, the report was published in Arabic, the proposals were welcomed and the ascendancy of the Moderate party was re-established. The following invitation was then addressed to the sultan of Egypt:—

"His majesty's Government after a study of the proposals made by Lord Milner have arrived at the conclusion that the status of protectorate is not a satisfactory relation in which Egypt should continue to stand to Great Britain. While they have not reached final decisions with regard to Lord Milner's recommendations, they desire to confer regarding them with a delegation nominated by your highness, with a view, if possible, to substitute for the protectorate a relationship which would, while securing the special interests of Great Britain and enabling her to offer adequate guarantees to foreign Powers, meet the legitimate aspirations of Egypt and the Egyptian people."

Adly Pasha then formed a ministry with a programme designed to secure the co-operation of the Nationalists; but Zaghlul lost no time in attacking the new Government. His philippics, and the weakness of the administration in dealing with mob violence at Tanta, led to outbreaks in Cairo and Alexandria, directed in the latter city chiefly against the Greeks. A military court of enquiry attributed responsibility to the Zaghlulist party. Sixteen of the rioters found guilty were executed and a large number were condemned to lighter sentences.

Negotiations with Adly.—Six months had elapsed since the presentation of the Milner report before a delegation under the presidency of Adly, pledged to demand the abolition of the protectorate and the maintenance of the reserves formulated, proceeded to London in July 1921. In the ensuing conversations, all reference to the Sudan was avoided as it had been in negotiations

[illegible] n oke own com le ly on [illegible] ere unable to g e [illegible] British troops would withdraw towards the canal zone as soon as conditions in Egypt were stabilized. Adly, while ready to accept the permanent establishment of a British military force to protect imperial communications, claimed that it should be restricted to a defined area in peace time, and that there should be no interference in the internal affairs of Egypt. When the impasse became final, Adly resigned: a successor could not be found: and disorder again broke out. Zaghlul, though badly received in Upper Egypt, continued to agitate in Lower Egypt, where demonstrations assumed a menacing character after the publication of the note to the sultan, and two British soldiers were shot. In view of their defiant attitude, Zaghlul and his chief supporters were ordered to retire to their country estates; as they proved recalcitrant, he and five others were deported by the British authorities.

Egypt Declared Independent.—The disturbances, which had taken a serious form in Cairo, were vigorously suppressed and by the end of the year (1921) conditions were favourable for a further endeavour to terminate a situation which could not be allowed to continue. Lord Allenby proceeded to London with his proposals and his resignation in his pocket; but he was back in Cairo within a month; and on Feb. 28, the day after his return, the following declaration was published:

"Whereas H.M. Government in accordance with their declared intentions desire to recognize Egypt as an independent sovereign State, and

"Whereas the relations between H.M. Government and Egypt are of vital importance to the British empire, the following principles are hereby declared:

"(1) The British protectorate over Egypt is terminated and Egypt is declared to be an independent sovereign State.

"(2) So soon as the Government of his highness shall pass an Act of Indemnity with application to all inhabitants of Egypt martial law as proclaimed on Nov. 2, 1914, shall be withdrawn.

"(3) The following matters are absolutely reserved to the discretion of H.M. Government until such time as it may be possible by free discussion and friendly accommodation on both sides to conclude agreements in regard thereto between H.M. Government and the Government of Egypt: (*a*) the security of the communications of the British empire in Egypt; (*b*) the defence of Egypt against all foreign aggression or interference direct or indirect; (*c*) the protection of foreign residents in Egypt and the protection of minorities; (*d*) the Sudan. Pending the conclusion of such agreements, the *status quo* in all these matters shall remain intact."

Although carefully protecting himself from acceptance of the terms of this declaration, Sarwat Pasha set to work to form a ministry with a programme contemplating a democratic constitution, ministerial responsibility and the revocation of martial law. The sultan assumed the title of king and proclaimed Egypt a monarchy. An Egyptian minister for foreign affairs was once more appointed. The British Government informed the Powers (March 15, 1922) that special relations between Great Britain and Egypt would always be maintained as an essential British interest. They could admit no question or discussion of those special relations, and any interference in the affairs of Egypt by any other Power would be regarded by them as an unfriendly act.

The Constitution, drafted by a representative commission, was completed by Oct. 1922. H.M. Government took exception to the ascription to King Fuad in the draft of the title of "king of Egypt and the Sudan" as well as to other clauses referring to the latter region. Acute differences also arose between the ministry and the king, whose views regarding the suitability of democratic institutions for Egypt seemed hardly consistent with his public utterances. Sarwat consequently resigned in November and Tewfik Nessim became prime minister for the second time. A further series of outrages on British subjects had meanwhile continued unchecked, culminating in the assassination in broad daylight of Prof. Newby Robson by three students. The Egyptian Government were informed that the continuance of these attacks would make impossible the abolition of martial law. Tewfik was anxious to promulgate the Constitution before announcing an Indemnity Act. But the king at first strenuously resisted a modification of his title, and a period of tension ensued. Tewfik Pasha resigned and an interregnum of five weeks followed, during which a recrudescence of murder and bomb-throwing rendered a severer application of martial law inevitable. Yehia Ibrahim Pasha finally formed an administration which assumed office in March 1923, and the Constitution was promulgated on April 19, 1923.

The New Constitution.—A constitutional monarchy was thereby established with two houses, a senate and a chamber of deputies, and a ministry responsible to the lower chamber. Deputies, 220 in number, were chosen by universal suffrage, under the old system of indirect election, for five years. The senate could not be dissolved. Two-fifths of its members were appointed by the Sovereign and three-fifths are elective, with a mandate for ten years. One half of each category was renewable every five years. A two-thirds' majority in each house was necessary for a revision of the Constitution. An Act of Indemnity prohibiting any process or plea calling in question acts under martial law was issued in July and that jurisdiction, continuously in force since Nov. 1914, was then terminated by a proclamation of the commander-in-chief and an exchange of notes between the British and Egyptian Governments. Yehia also carried through a law governing the retirement and compensation of foreign officials in the Egyptian service; and vigorous efforts to suppress the murder campaign met with some success.

Zaghlul was now permitted to return from exile; he was received with enthusiasm; and at the elections to the Chamber of Deputies in Jan. 1924, he was given an overwhelming majority of 188 supporters. In the senate he was equally strong. Yehia, who had deserved well of his country during the transitional period, resigned and Zaghlul formed a ministry. The almost simultaneous advent to power of a Labour Government in England revived Egyptian hopes that the Sudan policy would be reconsidered. But a declaration made (June 25) in the House of Lords by Lord Parmoor that the British Government did not intend to evacuate the Sudan evoked violent protests from Zaghlul. Nor was the statement in the House of Commons by J. Ramsay MacDonald a few days later more encouraging, though he expressed the hope that the Egyptian prime minister would come to England to discuss the issue. The latter, who was now completely master of the situation at Cairo, had repeatedly affirmed that he would only accept discussion on the basis of the incorporation of the Sudan in Egypt. In view of the unequivocal attitude of the British Government and parliament, he tendered his resignation, which was, however, not accepted. When about to start for Alexandria, where the court was established for the summer, he was shot at and wounded by a young Egyptian who appeared to be of unbalanced mind and not closely connected with any political movement. He recovered quickly and proceeded to Europe to recruit his health.

Meanwhile Nationalist propaganda had transferred its activity to the Sudan, and disturbances, of which there had been some premonition a few weeks earlier, broke out (Aug. 9–11) at Khartoum, the Atbara post and Port Sudan. A proposal from Cairo for an Egyptian-Sudanese commission of enquiry elicited the reply from the British Government that the governor-general was alone responsible for order in the Sudan. In certain other directions the position became more definite. The British Government announced that, having ceased to be a dependency of the sultan, Egypt could no longer be held liable for the tribute to Turkey. As the tribute had been made the security for two Turkish loans, the disclaimer of liability presented serious difficulties. It was proposed that a conference of interested Powers should study the question or that it should be referred to the International Court at The Hague.

The Crisis of 1924-25.—After more than one invitation from J. Ramsay MacDonald, a meeting between the British and Egyptian prime ministers eventually took place in London (Sept. 25–Oct. 3, 1924), but it was fruitless in results owing to the inordinate pretensions of Zaghlul who, when [illegible] endence became an accomplished fact, [illegible] to recipro-

cal conces ons He was nformed by J R MacDonald tha no Br h Go ernment could divest tse of i s nterest in guarding the Suez canal for which secur ty must be provided in any agreement between Great Britain and Egypt. Effective co-operation might have been established by a treaty of alliance. The British force to be maintained in Egypt would neither interfere with the functions of its Government nor encroach upon its sovereignty. He adhered to the declaration made in the House of Commons that no arrangement which would jeopardise the administration and development of the Sudan could be contemplated. At the same time the special interest of Egypt in the water supply was recognized as well as certain financial claims against the Sudan Government. These interests Great Britain was prepared to secure. The contrast between the two points of view was irreconcilable, and Zaghlul's Government responded by replacing men of moderate opinions in the public service with uncompromising Nationalists. Zaghlul returned from London, engaged in an attack on the Palace and tendered a resignation which the king did not dare to accept. Events were marching steadily to a crisis.

The crisis came on Nov. 19, 1924, when Sir Lee Stack, the sirdar and governor-general of the Sudan, was shot in broad daylight while driving through the streets of Cairo. The assassination roused a storm of indignation in Great Britain. Rigorous measures were called for. The demands put forward by Lord Allenby (*British note of Nov. 22*) were tantamount to an ultimatum. They required:

1. An ample apology for the crime.
2. An enquiry into the authorship of the crime with the utmost energy and without respect of persons, and the condign punishment of the criminals, whoever and whatever their age might be.
3. The prohibition and vigorous suppression of all popular political demonstrations.
4. The payment forthwith to the British Government of a fine of £500,000.
5. The withdrawal from the Sudan within 24 hours of all Egyptian officers and the purely Egyptian units of the Egyptian army.
6. Notification to the competent department that the Sudan Government would increase the area to be irrigated at Gezira from 300,000 feddans to an unlimited figure as need might arise.
7. The withdrawal of all opposition in the respects to be specified later to the wishes of the British Government concerning the protection of foreign interests in Egypt.

If these demands were not immediately complied with, the British Government would at once take appropriate action to safeguard their interests in Egypt and the Sudan.

The Egyptian Government accepted the first four, but demurred to the last three of the demands, whereupon the British authorities took immediate action. Instructions were sent to the Sudan Government to effect the removal of all Egyptian officers and of the purely Egyptian units. The restriction of the irrigable area of the Gezira to 300,000 feddans would be regarded as no longer binding. At the same time the customs at Alexandria were occupied by a British force. Certain individuals under suspicion of conspiracy were arrested by the British but handed at once to the Egyptian authority. These vigorous measures inevitably led to the resignation of Zaghlul, who was replaced by Ahmed Pasha Ziwar, the president of the Senate, with a ministry of moderate views. They lost no time in negotiating a settlement with the British Government which secured the evacuation of the customs, after which they were joined by Ismail Sidky Pasha. A mutiny in a section of the Sudanese troops at Khartoum which broke out at this moment was rapidly suppressed. The Egyptian parliament was adjourned and finally dissolved at the end of 1924. An appeal which it had addressed to the League of Nations and to the parliaments of other countries for intervention remained without response.

A new Union party (*Ittihad*), formed under the inspiration of the Palace, had for its object to draw away from Zaghlul's party, the *Wafd*, many of those to whom his intransigence had become distasteful. On the reassembling of parliament, however (March 23, 1925), Zaghlul defeated the ministerial candidate for the presidency of the Chamber by a majority of 40, and it became evident that the Independents had repudiated their undertaking to separate themselves from the *Ittihad*. In view of the support thus openly given to the leader whose policy had led up to the British ultimatum, the ministry recommended the king to dissolve the newly elected parliament. Eleven months were to elapse before it was re-elected; and in the interval a commission under the chairmanship of Ismail Sidky, in which the Liberal element predominated was appointed to revise the electoral law so as to restrict the suffrage. The opposition appeared for the moment disconcerted and disarmed; and in May a number of persons were brought to trial for complicity in the murder of Sir Lee Stack. Seven of them were executed, and one sentenced to penal servitude for life.

Lord Lloyd's Tenure of Office.—Lord Allenby took advantage of the apparent lull to resign the high commissionership in May. He was succeeded in Oct. 1925 by Lord (formerly Sir George) Lloyd, who found the autocratic power of the Palace reviving in the absence, for health reasons, of the prime minister in Europe and in default of a parliament. The influence of Nashat Pasha, the head of the king's privy cabinet and his most trusted adviser, had become paramount. In promoting the formation of the *Ittihad* party his object had been to eliminate from power the Liberals, who were strenuously opposed to any extension of the royal prerogative. The chief result was to drive the Liberals into the arms of the Wafd, Zaghlul giving them satisfactory guarantees and losing no opportunity of impressing on the Liberals, as well as on the *Ittihad*, their dependence upon his support. The collapse of the latter was marked by the transfer of Nashat to a diplomatic post—the first indication of the influence exercised by Lord Lloyd. When at last a new parliament was elected in May 1926, it showed an overwhelming majority for the Nationalists, who were returned with some 150 candidates against about 30 Liberals, 5 Nationalists, 20 Independents and 10 Unionists.

The efforts of the police authorities and the support which they received from Ziwar had succeeded by the beginning of 1926 in bringing before the Egyptian courts the remainder of the culprits responsible for the political crimes which had occurred in Egypt since 1920. Among them were two members of Zaghlul's Government, Ahmed Maher, formerly minister of education, and Mahmud Nekrashi, under-secretary of the interior. To the consternation of the more moderate Egyptians and all foreigners, the trial at the end of May 1926 ended in their acquittal, but the verdict also involved, as a protest, the resignation of Judge Kershaw, the British member of the tribunal on the grounds that it had been given by his two Egyptian colleagues in defiance of the evidence brought before the court. On June 2 a note was presented to the Egyptian Government by Britain, declining to accept the verdict as establishing the innocence of the persons acquitted, and reserving liberty to ensure the safety of foreigners in Egypt.

Prior to the elections, Zaghlul Pasha had several times announced that it was not his intention to form a Government himself. It was clearly impossible, however, for Ziwar to carry on in face of the Wafd triumph: and he resigned just before the new parliament met. He was succeeded by Adly Pasha, with a coalition cabinet, while Zaghlul was re-elected president of the chamber. During the session which opened in Nov. 1926, the main political issues were the continuance of the contribution by Egypt to the defence force which had replaced the dismissed Egyptian garrison in the Sudan; the question of abrogating the capitulations; the treatment of foreign officials under the Egyptian Government, and a proposal that the village headman should be elected instead of, as before, appointed by Government. Outside the sphere of politics the chief events were the opening (Dec. 1926) of Port Fuad, opposite Port Said, which may in time become the southern harbour of Palestine; and the International Cotton Spinners' Congress held at Cairo in Jan. 1927, to consider the serious decline in the quantity and quality of the exports of Egyptian cotton.

By the spring of 1927 Adly's position was becoming impossible. His cabinet was disunited, his Government was constantly heckled by the Wafdists, who ostensibly owed it their support. In April he seized on a trivial excuse to resign, and Abdul Khalik Pasha Sarwat was summoned as prime minister. Although a Liberal, he was unable to change the constitution of the cabinet which indeed

[illegible] He was [illegible] power [illegible] [illegible] a [illegible] for substantially [illegible] [illegible] Egyptian army, to which the British Government objected. This difference being satisfactorily adjusted, a further effort was made to cement more friendly relations by the warmth with which King Fuad was received on his visiting England (July 4–26). Sarwat accompanied him; and the opportunity was taken by the foreign secretary (Sir Austen Chamberlain) to discuss informally all the outstanding issues between Britain and Egypt. The atmosphere was very different from that which had surrounded the earlier conversations with Zaghlul, and after much mutual give-and-take, a draft treaty of alliance between the two countries was hammered out, which Sarwat accepted during a second visit to London, and which ultimately met with the approval of the British and Dominion Governments. Before it could be forwarded officially to Cairo, Zaghlul died (Aug. 23, 1927), at the age of 74. The greatest national leader since Arabi, he had fought an unflinching battle for the independence of his country, and his death was the signal for a striking and genuine outburst of national grief. In his stead, the leadership of the Wafd was conferred on Mustapha Pasha Nahas, and the Wafd and Liberals combined in a declaration of their determination to remain united in following the principles of the dead leader.

The Draft Treaty of 1927.—The agreed draft, which reached Cairo late in Nov. 1927, provided for an alliance between Britain and Egypt. If Egypt were attacked, Britain would immediately come to her aid; and if Britain were menaced with or engaged in war, Egypt would furnish all facilities and assistance in her power. Egypt would not adopt in foreign countries an attitude hostile to the alliance; she would not oppose British policy abroad, or enter into any foreign agreement prejudicial to British interests. The Egyptian army would be trained on British methods, and any foreign instructors employed would be British subjects. The lines of communication in the British empire would be protected by such British forces in Egypt as Britain considered necessary: and after ten years the location of those forces would be reconsidered, any difference of opinion on the point being submitted to the League of Nations. Britain would use its influence to get the capitulations modified and to get Egypt admitted to the League of Nations. There were some detailed provisions regarding the Egyptian army, and for financial and judicial advisers. The lives and property of foreigners in Egypt were, if threatened, to be the subject of special consultation between the two Governments. The whole problem of the Sudan was left for future settlement.

On the receipt of the document Sarwat delayed action and sheltered himself behind a stream of requests for the interpretation of passages in the draft. Ultimately, under pressure from the British Foreign Office, he showed the draft to Nahas (Feb. 8, 1928), while still withholding it from his colleagues in the cabinet. With him clearly it was the Wafd, and the Wafd alone, which counted, and his dilatoriness had encouraged the Wafd to resume their old intransigent attitude. Nahas made no secret of his hostility to the treaty; as it did not provide for the complete evacuation of Egypt by the British army, it was not, he alleged, worth a moment's consideration. On March 4, Sarwat informed Lord Lloyd that the cabinet had refused to discuss the draft, and that he was accordingly resigning. Thus ended the most promising attempt since Lord Milner's conversations with Zaghlul, to get on to terms with the Nationalists. Nahas became premier and formed a Wafdist cabinet, containing only two Liberal members (March 16).

King Fuad's Coup.—To this rebuff the British Foreign Office replied by drawing attention to certain legislative proposals which it described as reckless, and prejudicial to the safety of foreigners in Egypt. After an ultimatum and the despatch of some warships from Malta, the chief offending measure, the Assemblies bill, was postponed until November. A crisis of an entirely different character, however, ensued immediately. Two Cairo newspapers, on June 24, published photographs of documents which, if authentic, would have seriously compromised Nahas and two other prominent Wafdists. Nahas denied their genuineness and the intrigue which they purported to disclose; but the king dismissed him and his cabinet on the following day. Mohammed Pasha Mahmud, one of the two Liberal members of Nahas's original cabinet, accepted office and formed a ministry combining Liberals with the less extreme section of Wafdists. On July 19, 1928, King Fuad dissolved parliament which was not to assemble again for three years; he determined to carry on the Government by royal decree. The new prime minister announced his intention of acting as a benevolent dictator, and of clearing up the mess into which the public services had been thrown by the Wafd. The change was well received by the country, despite some strikes organized by way of protest. In Oct. 1928 the official enquiry into the charges against Nahas Pasha, concluded in a report that there was no case for a prosecution.

BIBLIOGRAPHY.—*For the earlier part of this section*, D. A. Cameron, *Egypt in the 19th Century*, continues a useful summary; *see* also P. Mouriez, *Histoire de Méhémet-Ali* (4 vols.). For the period immediately preceding and lasting through Lord Cromer's time, his own work, *Modern Egypt* (2 vols., 1911), is the standard guide; *see* also his *Annual Reports* to the British Government and Alfred (Lord) Milner's *England in Egypt* (11th ed., 1904), and Sir A. Colvin's *The Making of Modern Egypt* (1906). Blue books continue, in altered form, down to date; and the more recent general works are Sir V. Chirol, *The Egyptian Problem* (1920); W. S. Blunt, *The Secret History of the English Occupation of Egypt* (1923), a strongly partisan presentation; P. G. Elgood, *Egypt and the Army* (1924); M. T. Symons, *Britain and Egypt* (1925); George Young, "*Egypt*," in the *Modern World* series (1927); E. W. P. Newman, *Great Britain in Egypt* (1928). (J. R. Ro.; Mr.)

EGYPT AND SUDAN CAMPAIGNS (1882–1900)

In Feb. 1879 discharged officers and soldiers mutinied at Cairo, which led to the despatch of British and French ships to Alexandria. On June 26 Ismail Pasha was removed from Egypt, and Tewfik assumed the khediviate, becoming practically the *protégé* of the two western powers. On Feb. 1, 1881 a more serious disturbance arose at Cairo from the attempt to try three colonels, Ahmed Arabi, Ali Fehmy and Abd-el-Al, who had been arrested as the ringleaders of the military party. The prisoners were released by force, and proceeded to dictate terms to the khedive. Again British and French warships were despatched to Alexandria, and were quickly withdrawn, their presence having produced no apparent impression. It soon became clear that the khedive was powerless, and that the military party, headed by Arabi, threatened to dominate the country. The "dual note," communicated to the khedive on Jan. 6, 1881, contained an intimation that Great Britain and France were prepared to afford material support if necessary; but the fall of Gambetta's ministry produced a reaction, and both governments proceeded to minimize the meaning of their language. The khedive was practically compelled to form a government in which Arabi was minister of war and Mahmud Sami premier, and Arabi took steps to extend his influence throughout his army. The situation now became critical: for the third time ships were sent to Alexandria, and on May 25, 1882, the consuls-general of the two powers made a strong representation to Mahmud Sami which produced the resignation of the Egyptian ministry, but also a demand, to which the khedive yielded, by the military party for the reinstatement of Arabi. The attitude of the troops in Alexandria now became threatening; and on the 29th the British residents pointed out that they were "absolutely defenceless."

MILITARY OPERATIONS, 1882–1885

This warning was amply justified by the massacres of June 11, which took place almost under the guns of the ships in harbour. It was becoming clear that definite action would have to be taken, and by the end of June 26 warships, representing the navies of Great Britain, France, Germany, Italy, Austria, Russia, the United States, Spain, Greece and Turkey, lay off the port of Alexandria, and large numbers of refugees were embarked. The order received by Admiral Sir Beauchamp Seymour on July 3 was as follows:— "Prevent any attempt to bar channel into port. If work is resumed on earthworks, or fresh guns mounted, inform military commander that you have orders to prevent it; and if not immediately discontinued, destroy earthworks and silence batteries if they open fire, having given sufficient notice to population, shipping and foreign men-of-war."

On the 9th the admiral received a report that working parties had been seen in Fort Silsileh parbuckling two smoothbore guns—apparently 32-pounders—towards their respective carriages and slides, which were facing in the direction of the harbour." Fort Silsileh was an old work at the extreme east of the defences of Alexandria, and its guns did not bear on the harbour. On the 10th an ultimatum was sent to Toulba Pasha, the military commandant, intimating that the bombardment would commence at sunrise on the following morning unless "the batteries on the isthmus of Ras-el-Tin and the southern shore of the harbour" were previously surrendered "for the purpose of disarming." The fleet prepared for action, and the bearer of the reply, which offered to dismount three guns in the batteries named, only succeeded in finding the flagship late at night. This proposal was rejected, and at 7 A.M. on July 11 the "Alexandra" opened fire and the action became general. The attacking force was disposed in three groups: a squadron outside the reef, to engage the Ras-el-Tin and the earthworks under weigh; another inside the harbour, to engage the Meks batteries; and two men-of-war to take up assigned stations outside the reef and to co-operate with the inshore squadron. The five gunboats were to keep out of fire at first and seek opportunities of engaging the Meks batteries. Meks fort was silenced by about 12:45 P.M., and a party landed and disabled the guns. As the fire delivered under weigh was not effective, the offshore squadron anchored at about 10:30 A.M., and succeeded in silencing Fort Ras-el-Tin at about 12:30 P.M., and Fort Adda, by the explosion of the main magazine, at 1:35 P.M. The gunboat "Condor," followed by three others, engaged Fort Marabout soon after 8 A.M. till 11 A.M., when they were recalled. The bombardment ceased at 5 P.M.; but a few rounds were fired on the morning of the 12th at the right battery in Ras-el-Tin lines.

The bombardment of the forts of Alexandria was illuminating as a gauge of the slight effect to be expected from the fire of ships—under favourable conditions—compared with that of guns on shore, even though indifferently mounted, with poorly trained gunners and antiquated ordnance. Seventy-five hits were obtained on the hulls of the ships, of which 30 were unquestionably due to the old smoothbores, which were not provided with sights. The British ships engaged fired 1,741 heavy projectiles and 1,457 light. The result was comparatively small. About eight rifled guns out of 36 and 19 smoothbores out of 120 were dismounted or disabled. A considerable portion of this injury was inflicted, after the works had been silenced, by the deliberate fire of the ships. In the afternoon of the 12th, fires, which were the work of incendiaries, began to break out in the best quarters of Alexandria; and the town was left to murder and pillage till the following day, when a party of bluejackets and marines was landed at about 3 P.M.

Military intervention being now imperatively demanded, a vote of credit for £2,300,000 was passed in the British House of Commons on July 27. Five days later the French Government failed to secure a similar vote, and Great Britain was left to deal with the Egyptian question alone. An expeditionary force was organized in two divisions, with a cavalry division, corps troops and a siege train, numbering in all about 25,000 men. An Indian contingent numbering about 7,000 combatants was prepared for despatch to Suez. Gen. Sir Garnet Wolseley was appointed commander-in-chief. The expeditionary force having assembled at Alexandria, the Suez Canal was seized and Ismailia occupied as the base for an advance on Cairo. Meanwhile the bulk of the expeditionary force was taken eastwards to Port Said, a naval demonstration being made at Abukir to deceive the enemy as to the object of the main movement in progress. The advance inland westwards towards Cairo now began. On Aug. 21 an advanced detachment moved from Ismailia occupying Nefiche, the junction with the Suez line. Reconnaissances showed that the enemy had dammed the sweet-water canal and blocked the railway at Tell-el-Mahuta, where entrenchments had been thrown up. But the advanced guard had now outrun its supplies, while a considerable force was distributed at intervals along the line Ismailia-Kassassin. The situation on the 27th tempted attack by an enterprising enemy, and Maj.-gen. Graham's force was in danger of being overwhelmed by superior numbers from Tell-el-Kebir. On Aug. 5 and Sept. 9 the Egyptians attacked Kassassin, but were repulsed. Meanwhile strenuous efforts were made to bring up supplies and troops for an attack on Tell-el-Kebir, held by about 38,000 men with 60 guns. The Egyptian defences consisted of a long line of trench (two and a half miles) approximately at right angles to the railway and the sweet-water canal. At 11 P.M. on Sept. 12 the advance of about 15,000 men commenced: the 1st division, under Lieut.-gen. Willis, was on the right, and the 2nd division, under Lieut.-gen. Hamley, was on the left. Seven batteries of artillery were placed in the centre. The cavalry, under Maj.-gen. Drury Lowe, was on the right flank, and the Indian contingent, under Maj.-gen. Macpherson, starting one hour later, was ordered to move south of the sweet-water canal. The night was moonless, and the distance to be covered about 6½ miles. The ground was perfectly open, slightly undulating and generally firm gravel. The conditions for a night march were thus ideal; but during the movement the wings closed towards each other, causing great risk of an outbreak of firing. The line was, however, rectified, and after a halt the final advance began. By a fortunate accident an isolated outwork was just missed in the darkness by the left flank of the 2nd Division; otherwise a premature alarm would have been given, which must have changed all the conditions of the operation. At dawn the Highland Brigade of the 2nd Division struck the enemy's trenches, and carried them after a brief struggle. The 1st Division attacked a few minutes later, and the cavalry swept round the left of the line of entrenchments, cutting down any fugitives who attempted resistance and reaching the enemy's camp in rear. The Indian contingent, on the south of the canal, co-operated, intercepting the Egyptians at the canal bridge. The opposition encountered at some points was severe, but by 6 A.M. all resistance was at an end. The British loss amounted to 58 killed, 379 wounded and 22 missing; nearly 2,000 Egyptians were killed, and more than 500 wounded were treated in hospital. An immediate pursuit was ordered, and the Indian contingent reached Zagazig, while the cavalry occupied Belbeis and pushed on to Cairo, 65m. from Tell-el-Kebir, next day. On the evening of the 14th the 10,000 troops occupying Abbasia barracks, and 5,000 in the citadel of Cairo, surrendered. The prompt following up of the victory at Tell-el-Kebir saved Cairo from the fate of Alexandria and brought the rebellion to an end—25 days from the landing at Ismailia to the occupation of Cairo. For the Egyptian troops elsewhere promptly surrendered.

The authority of the khedive and the maintenance of law and order now depended absolutely on the British forces left in occupation. Lord Dufferin, who had been sent to Cairo to draw up a project of constitutional reforms, advocated the re-establishment of a native army, not to exceed 5,000 to 6,000 men, with a proportion of British officers for purely defence purposes within the Delta; and Sir Evelyn Wood left England to undertake the organization of this force, with the title of *sirdar*. A gendarmerie of 4,400 was also formed, under Baker Pasha (Gen. Valentine Baker) as inspector-general.

In a despatch of Feb. 6, 1883, Lord Dufferin dealt with the Sudan, and stated that Egypt "could hardly be expected to acquiesce" in a policy of withdrawal from her southern territories. At the same time he pointed out that, "Unhappily, Egyptian administration in the Sudan had been almost uniformly unfortunate. The success of the present mahdi in raising the tribes and extending his influence over great tracts of country was a sufficient proof of the government's inability either to reconcile the inhabitants to its rule or to maintain order." Moreover, to restore tranquillity in the Sudan, "the first step necessary was the construction of a railway from Suakin to Berber, or what, perhaps, would be more advisable, to Shendi, on the Nile. The completion of this enterprise would at once change all the elements of the problem."

The immense responsibilities involved were most imperfectly understood by the British Government. Egyptian sovereignty in the Sudan dated from 1820, and in 1877 Gordon had become governor-general of the Sudan, where he laboured to destroy the slave trade and to establish just government. In Aug. 1879 he

[illegible] C[illegible]o and [illegible] succeeded b[illegible] Raou[illegible] Pa[illegible]ha [illegible] [illegible] throughout t[illegible]e Sudan while the [illegible] C[illegible]don's stern measures, were ready to revolt. The authority of Egypt was represented by scattered garrisons of armed men, badly officered, undisciplined and largely demoralized. In such conditions a leader only was required to ensure widespread and dangerous rebellion. A leader appeared in the person of Mohammed Ahmed, who, acquiring great reputation for sanctity, had actively fomented insurrection. In Aug. 1881 a small force sent by Raouf Pasha to arrest Mohammed Ahmed was destroyed, and the latter, proclaiming himself the mahdi, stood forth as the champion of revolt. Thus, at the time when the Egyptian army was broken up at Tell-el-Kebir, the Sudan was already in flames. These spread in face of the ineffective efforts of a rapidly changed succession of Egyptian governor-generals. An Egyptian force was improvised and despatched by the khedive to Khartoum via Suakin. In March 1883 Col. William Hicks, late of the Bombay army, found himself at Khartoum in command of nine European officers and about 10,000 troops of little military value. The reconquest of the Sudan having been determined upon, although Sir E. Malet reported that the Egyptian Government could not supply the necessary funds, and that there was great risk of failure, Hicks started from Khartoum on Sept. 9 for Kordofan.

Col. Hicks was fully aware of the unfitness of his rabble forces for the contemplated task, and on Aug. 5 he telegraphed: "I am convinced it would be best to keep the two rivers and province of Sennar, and wait for Kordofan to settle itself." Early in November the force from Khartoum was caught by the mahdists short of water at Kashgil, near El Obeid, and was almost totally destroyed, Col. Hicks, with all his European officers, perishing. Sinister rumours having reached Cairo, Sir E. Baring (Lord Cromer), who had succeeded Sir E. Malet, telegraphed to London that "if Col. Hicks's army is destroyed, the Egyptian Government will lose the whole of the Sudan, unless some assistance from the outside is given," and advised the withdrawal to some post on the Nile. On the following day Lord Granville replied: "We cannot lend English or Indian troops; if consulted, recommend abandonment of the Sudan within certain limits"; and on the 25th he added that "Her Majesty's Government can do nothing in the matter which would throw upon them the responsibilities for operations in the Sudan." In a despatch of Dec. 3 Baring forcibly argued against British intervention in the affairs of the Sudan; on Jan. 4, 1884 he was directed to insist upon the policy of evacuation, and on the 18th Gen. Gordon left London to assist in its execution.

The year 1883 brought a great accession of power to the mahdi, who had captured about 20,000 rifles, 19 guns and large stores of ammunition. On the Red Sea littoral Osman Digna, a slave dealer of Suakin, appointed *amir* of the Eastern Sudan, raised the local tribes, invested Sinkat and Tokar, and destroyed Egyptian reinforcements sent thither. On Dec. 23 Baker, followed by about 2 500 men, gendarmerie, blacks, Sudanese and Turks, with ten British officers, arrived at Suakin to prepare for the relief of Sinkat and Tokar. The tragedy of Kashgil was repeated on Feb. 4 when Gen. Baker's heterogeneous force, on the march to Tokar, was routed at El Teb by an inferior body of tribesmen. Of 3,715 men, 2,375 with 11 European officers were killed. Suakin was now in danger, and on Feb. 6 British bluejackets and marines were landed for the defence of the town.

Two expeditions in the Sudan led by British officers having thus ended in disaster, and Gordon with Lieut.-col. J. D. Stewart having reached Khartoum, the policy of British non-intervention could no longer be maintained. Public opinion in England was strongly impressed by the fact that the Egyptian garrisons of Tokar and Sinkat were perishing within striking distance of the Red Sea littoral. A British force about 4,400 strong, with 22 guns was rapidly concentrated at Suakin and placed under the orders of Maj.-gen. Sir G. Graham. News of the fall of Sinkat, where the starving garrison, under Tewfik Bey, made a gallant sortie and was cut to pieces, reached Suakin on Feb. 12. On the 24th Gen. Graham's force disembarked at Trinkitat and received information of the surrender of Toka[illegible] At 8 A.M. on the 29th he force advanced towards Tokar in square, and came under fire at 11:20 A.M. from the enemy entrenched at El Teb. The tribesmen made desperate efforts to rush the square, but were repulsed, and the position was taken by 2 P.M. The cavalry, 10th and 19th Hussars under Brig.-gen. Sir H. Stewart, became involved in a charge against an unbroken enemy, and suffered somewhat severely. The total British loss was 34 killed and 155 wounded; that of the tribesmen was estimated at 1,500 killed. On the following day Tokar was reached, and on March 2 the force began its return to Suakin, bringing away about 700 rescued people. On March 9 the whole force was back at Suakin, and on the evening of the 11th an advance to Tamai began, and the force bivouacked and formed a zariba in the evening. Information was brought by a native that the enemy had assembled in the Khor Ghob, a deep ravine not far from the zeriba. At about 8:30 A.M. on the 13th the advance began in echelon of brigade squares from the left. The left and leading square (2nd Brigade) moved towards the khor, approaching at a point where a little ravine joined it. The enemy showing in front, the leading face of the square was ordered to charge up to the edge of the khor. This opened the square, and a mass of tribesmen rushed in from the small ravine. The brigade was forced back in disorder, and the naval guns, which had been left behind, were temporarily captured. After a severe hand-to-hand struggle, in which the troops behaved with great gallantry, order was restored and the enemy repulsed, with the aid of the fire from the 1st Brigade square and from dismounted cavalry. The 1st Brigade square, having a sufficient field of fire, easily repelled all attempts to attack, and advancing as soon as the situation had been restored, occupied the village of Tamai. The British loss was 109 killed and 104 wounded; of the enemy nearly 2,000 were killed. On the following day the force returned to Suakin.

Two heavy blows had now been inflicted on the followers of Osman Digna, and the road to Berber could have been opened, as Graham suggested and Gordon urged. It was at first opposed by Sir E. Baring who, however, realized soon afterwards the gravity of the situation and telegraphed on March 16:—"It has now become of the utmost importance not only to open the road between Suakin and Berber, but to come to terms with the tribes between Berber and Khartoum." The Government refused to take this action and Graham's force was broken up, leaving one battalion to garrison Suakin.

The abrupt disappearance of the British troops encouraged the tribesmen led by Osman Digna. The first attempt at intervention in the affairs of the Sudan had been made too late to save Sinkat and Tokar. It resulted only in heavy slaughter of the tribesmen, which afforded no direct or indirect aid to Gordon or to the policy of evacuation. The public announcement of this policy increased Gordon's difficulties, and the situation at Khartoum grew steadily worse. On March 24 Sir E. Baring telegraphed:—"The question now is, how to get Gen. Gordon and Col. Stewart away from Khartoum. . . . Under present circumstances, I think an effort should be made to help Gen. Gordon from Suakin, if it is at all a possible military operation. . . . We all consider that, however difficult the operations from Suakin may be, they are more practicable than any operations from Korosko and along the Nile." A telegram from Gordon, received at Cairo on April 19, stated that "We have provisions for five months and are hemmed in. . . . Our position will be much strengthened when the Nile rises. . . . Sennar, Kassala and Dongola are quite safe for the present."

At the same time he suggested "an appeal to the millionaires of America and England" to subscribe money for the cost of "2,000 or 3,000 nizams" (Turkish regulars) to be sent to Berber. A cloud now settled down upon Khartoum, and subsequent communications were few and irregular. The Foreign Office and Gordon appeared to be somewhat at cross purposes. The former hoped that the garrisons of the Sudan could be extricated without fighting. The latter, judging from some of his telegrams, believed that to accomplish this entailed the suppression of the mahdi's revolt, the strength of which he at first greatly under-estimated. On March 9 Gordon proposed "if the immediate evacuation of Khartoum is det[illegible] upon [illegible]e of out lying towns [illegible] to send [illegible]

h Cairo e ploy es and the garr son to Berber to e gn h comm s on and to proceed h the stores and he steamers to e equa orial pro nces, which he would consider as placed under the king of the Belgians On March 13 Lord Granville gave full power to Gordon to "evacuate Khartoum and save that garrison by conducting it himself to Berber without delay," and expressed a hope that he would not resign his commission.

By the end of March the growing danger to Gordon, with the grave national responsibility involved, began to be realized in Great Britain. Sir Henry Gordon, however, who was in personal communication with Mr. Gladstone, considered that his brother was in no peril, and for some time disbelieved in the need for a relief expedition. Meanwhile it was at least necessary to evolve some plan of action, and on April 8 Lord Wolseley, the adjutant-general, drew up a memorandum detailing the measures required for placing 6,500 British troops "in the neighbourhood of Shendi." The controversial "battle" of the routes began much earlier, and was continued for some months Practically the choice lay between the Nile and the Suakin-Berber road. The first involved a distance of 1,650m. from Cairo along a river strewn with cataracts, which obstructed navigation to all but small boats, except during the period of high water. So great was this obstruction that the Nile had never been a regular trade route to the Sudan. The second entailed a desert march of about 250m., of which one section, Obak-Bir Mahoba (52m.), was waterless, and the rest had an indifferent water supply (except at Ariab, about half-way to Berber), but capable of development. From Berber the Nile is followed (210m.) to Khartoum. This was an ancient trade route with the Sudan, and had been used without difficulty by the reinforcements sent to Hicks Pasha in 1883. The authorities in Egypt were unanimous in favour of it. From the first Maj.-gen. Sir A. Clarke, then inspector-general of fortifications, strongly urged this plan, and proposed to begin at once a metre gauge railway from Suakin. Preliminary arrangements were made, and on June 14 the Government sanctioned certain measures of preparation at Suakin. On the other side were the adjutant-general and a small number of officers who had taken part in the Red River expedition of 1870 in Canada (*q.v.*). Wolseley's memorandum had been based on the hypothesis that Khartoum could not hold out beyond Nov. 15, and that the expedition should reach Berber by Oct. 20. Steamers were to be employed in such reaches as proved practicable, but the force was to be conveyed in special whale-boats, by which "the difficulty of transport is reduced to very narrow limits." The question of routes continued to be argued and on July 29 a committee of three officers who had served in the Red River expedition reported:—"We believe that a brigade can easily be conveyed in small boats from Cairo to Dongola in the time stated by Lord Wolseley; and, further, that should it be necessary to send a still larger force by water to Khartoum, that operation will present no insuperable difficulties."

This inconclusive report, and the baseless idea that the adoption of the Nile route would involve no chance of bloodshed, which the Government was anxious to avoid, seem to have decided the question. Wolseley was appointed to take over the command in Egypt for the purposes of the expedition, and on Sept. 9 he arrived at Cairo, where the plan of operations was somewhat modified. A camel corps of 1,100 men selected from 28 regiments at home was added, and the "fighting force to be placed in line somewhere in the neighbourhood of Shendi" was fixed at 5,400. The construction of whale-boats began at once, the first batch arrived at Wadi Halfa on Oct. 14, and on the 25th the first boat was hauled through the second cataract. The mounted forces proceeded up the banks, and the first half-battalion embarked at Gemai, 87om. from Khartoum, on Nov. 5, ten days before the date to which it had been assumed Gen. Gordon could hold out. In a straggling procession the boats worked their way up to Korti, piloted by Canadian *voyageurs*. By Christmas day 2,220 men had reached Korti, of whom about 800 only had been conveyed by the whale-boats, the last of which did not arrive till Jan 27. Beyond Korti lay the very difficult section of the river to Abu Hamed, which was quite unknown. A letter from Gordon, dated Nov. 4 and received on Nov. 17, stated that his steamers would await the exped on at Me emma, and added, "We can hold out 40 days with ease; after that it will be difficult."

It was clear at Korti that something must be done at once; and on Dec. 13 a camel force under Gen. Sir H. Stewart was despatched to occupy Jakdul wells, 96m. on the desert route to Metemma Stewart returned on Jan. 5, 1885, and started again on the 8th with orders to establish a fort at Abu Klea and to occupy Metemma. The desert column, 1,800 men, with 2,880 camels in poor condition and 153 horses, found the enemy in possession of Abu Klea wells on the 16th, and was desperately attacked on the 17th The want of homogeneity of the force, and the unaccustomed tactics imposed upon the cavalry, somewhat hampered the defence, and the square was broken at the left rear corner. Driven back upon the camels in the centre, the troops fought hand to hand with the greatest gallantry. Order was quickly restored, and the attack was repulsed, with a loss of 74 killed and 94 wounded. At least 1,100 of the enemy were killed. After occupying the wells the column started again next evening. The wrong road was taken, and great confusion occurred during the night, but at dawn this was rectified; and after forming a rough fort under fire, by which Stewart was fatally wounded, the advance was resumed. Repulsing a fresh attack, the desert column, now greatly exhausted, on the 21st reached Metemma, which was found too strong to assault. On this day Gordon's four steamers arrived; and on the morning of the 24th Sir C. Wilson, on whom the command had devolved, with 20 British soldiers and about 280 Sudanese, started in the "Bordein" and "Telehawiyeh" for Khartoum. The "Bordein" grounded twice, by which 24 hours were lost. On the 28th Khartoum was sighted, and it soon became clear that the town was in the hands of the enemy. After reconnoitring farther, the steamers turned and proceeded down stream under a heavy fire, the Sudanese crews showing signs of disaffection. Both steamers were wrecked on the way back, but Wilson's party was rescued. Khartoum had been taken and Gordon killed on the morning of Jan. 26, having thus held out 34 days beyond the date when he had expected the end. The desert column, now in a precarious situation, increased by the breakdown of its transport, extricated itself by a return to Korti, while the river column was still 350m. below Khartoum when on Feb. 24 it received orders to retire. On Feb. 11, Wolseley, who had previously refused the offer of an active demonstration from Suakin, accepted the proposal of the Government to make a railway from there to Berber, as a means of supply.

Every effort was now concentrated upon sending an expeditionary force to Suakin, and before the end of March about 13,000 men, including a brigade from India and a field battery from New South Wales, with nearly 7,000 camels and 1,000 mules, were there assembled. Gen. Graham was placed in command of this force, with orders to break down the power of Osman Digna and to press the construction of the railway towards Berber. On March 19, Graham reconnoitred as far as Hashin and there next day inflicted a sharp reverse on the enemy, despite the natural difficulties of fighting in the dense mimosa scrub. On the 22nd a detachment with a large camel convoy started from Suakin for Tamai, but at a halt six miles out was attacked. Although caught partly unprepared, they repulsed the enemy, after a severe fight, before Graham's prompt aid arrived. After the repulse of a few lesser attacks, the railway was pushed on without interruption, reaching Otao on the 30th. On the night of May 6 a combined movement was made from Suakin and Otao, which resulted in the surprise and break-up of a force of the enemy and the seizure of a large number of sheep and goats. The moral effect of this operation was marked.

Meanwhile many communications had passed between the War Office and Wolseley, who at first believed that Berber could be taken before the summer. But by March 6 he had come to the opinion that it would be "impossible . . . to undertake any offensive operations until about the end of the summer, and only then with large reinforcements." A cloud having arisen on the frontiers of Afghanistan, the withdrawal of the troops from the Sudan was ordered in May. On June 22 before the British rearguard had left Dongola the mahdi died The withdrawal of

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MILITARY OPERATIONS, 1885 TO 1896

The operations against mahdism during the 11 years from the end of the Nile expedition and the withdrawal from the Sudan to the commencement of the Dongola campaign will be more easily understood if, instead of narrating them in one chronological sequence, the operations in each province are considered separately. On the death of the mahdi he was succeeded by the principal khalifa, Abdullah el Ta'aisha, a Baggara Arab, who for the next 13 years ruled the Sudan with despotic power. He was cruel, vicious, unscrupulous and strong, and the country groaned beneath his oppression. He removed all possible rivals, concentrated at Omdurman a strong military force composed of men of his own tribe, and maintained the ascendancy of that tribe over all others. As the British troops retired to Upper Egypt his followers seized the evacuated country, and the khalifa cherished the idea, already formulated by the mahdi, of the conquest of Egypt, but for some years he was too much occupied in quelling risings, massacring the Egyptians in the Sudan, and fighting Abyssinia, to move seriously in the matter.

Upper Egypt.—Mohammed el Kheir, dervish amir of Dongola, advanced towards the frontier in the autumn of 1885. After a month of small encounters, Sir Frederick Stephenson, commanding the British army of occupation in Egypt, concentrated the mixed British and Egyptian frontier field force at Firket, and attacked the main body of the enemy at Ginnis on Dec. 30, 1885, completely defeating it. It was here the new Egyptian army received its baptism of fire and acquitted itself creditably. Although checked, the dervishes were not discouraged, and continued to press upon the frontier in frequent raids. In April 1886 the frontier was drawn back to Wadi Halfa, a fortified camp at the northern end of the desolate defile, Batn-el-Hagar, through which the Nile tumbles amid black, rocky hills in a succession of rapids, and debouches on a wide plain. The protection of the frontier was now left in the hands of the Egyptian army, a British force remaining for two years longer at Aswân, 200m. to the north, as a reserve in case of emergency.

It was not until May 1889 that an invasion of the frontier on a large scale was again attempted. At this time the power and prestige of the khalifa were at their height; the rebellions in Darfur and Kordofan had been stamped out, the anti-mahdi was dead, and even the dervish defeat by the Abyssinians had been converted by the death of King John and the capture of his body into a success. It was therefore an opportune time to try to sweep the Turks and the British into the sea. On June 22 the amir Wad en Nejumi was at Sarras with over 6,000 fighting men and 8,000 followers. On July 2 Col. Wodehouse headed off and routed a part of this force at Argin. The sirdar, Gen. Grenfell, who had arrived to take the command in person, concentrated the Egyptian troops, with a squadron of the 20th Hussars, at Toski, and thence, on Aug. 3 gained a decisive victory with slight loss. The dervish army was practically destroyed and no further serious attempts were made to disturb the frontier, of which the most southerly outpost was at once advanced to Sarras.

The Eastern Sudan.—In 1884 Col. Chermside, governor of the Red sea littoral, entered into arrangements with King John of Abyssinia for the relief of the beleaguered Egyptian garrisons. Gera, Amadib, Senhit and Gallabat were, in consequence, duly succoured by the Abyssinians in 1885. Unfortunately famine compelled the garrison of Kassala to capitulate on July 30, and Osman Digna entrenched himself at Kufit with 10,000 men to oppose the Abyssinian general, Ras Alula. On Sept. 23 Ras Alula attacked him there with an equal number of men and routed him with great slaughter. Instead of marching on to Kassala, Ras Alula, who at this time was much offended by the transfer of Massawa by the Egyptians to Italy, made a triumphant entry into Asmara, and refused to make any further efforts to extricate Egyptian garrisons from the grip of the khalifa. Meanwhile Osman Digna, who had fled from Kufit to Kassala, wreaked his vengeance upon the unhappy captives at Kassala.

In the neighbourhood of Suakin there were many tribes disaffected to the khalifa's cause, and in the autumn of 1886 Col. H. Kitchener, who was at the time governor of the Red Sea littoral, judiciously arranged a combination of them to overthrow Osman Digna, with the result that his stronghold at Tamai was captured on Oct. 7. But at the end of 1887 Osman Digna again advanced towards Suakin, and although routed by the "Friendlies," he collected a large force again in 1888 and besieged Suakin. In December the sirdar arrived with reinforcements from Cairo, on the 20th sallied out and dislodged the dervishes from their trenches at Gemaiza, and the country was again fairly quiet for a time. In Jan. 1891 Osman Digna showed signs of increased activity, and Col. Holled Smith, then governor of the Red Sea littoral, advanced and on Feb. 19 fought the decisive action of Afafit, occupied Tokar, and drove Osman Digna back to Temrin with a loss of 700 men, including all his chief amirs. This action proved the final blow to the dervish power in the neighbourhood of Suakin, for although raiding continued on a small scale, the tribes were growing tired of the khalifa's rule and refused to support Osman Digna.

In the spring of the same year an agreement was made between England and Italy by which the Italian forces in Eritrea were at liberty, if they were able, to capture and occupy Kassala, which lay close to the western boundary of their new colony, on condition that they should ultimately restore it to Egypt. Three years passed before they availed themselves of this agreement. In 1893 the dervishes, 12,000 strong, under Ahmed Ali, invaded Eritrea, and were met on Dec. 29 at Agordat by Col. Arimondi with 2,000 men of a native force. Ahmed Ali's force was completely routed and himself killed, and in the following July Col. Baratieri, with 2,500 men, made a fine forced march from Agordat, surprised and captured Kassala and continued to hold it for three years and a half.

The Abyssinian Frontier.—In June 1886 *Ras* Adal invaded Gallabat and defeated the dervishes. In the following year dervish raids into Abyssinian territory led *Ras* Adal to collect a vast army for the invasion of the Sudan, but he was anticipated by the amir Abu Angar, a very skilful leader, who entered Abyssinia, defeated *Ras* Adal in the plain of Debra Sin after a prolonged battle, and marched on Gondar, the ancient capital, which he sacked before returning to Gallabat. King John, the negus of Abyssinia, burning to avenge this defeat, marched in 1889 to Gallabat where the khalifa's forces fortified the town and the camp. On March 9 the Abyssinians made a terrific onslaught, stormed and burnt the town, and took thousands of prisoners. But a stray bullet mortally wounded King John, and the Abyssinians decided to retire. That night, the greater part of the army having gone ahead with the prisoners, a party of Arabs pursued the rearguard, routed them, and captured the king's body, which was sent to Omdurman to confirm the story of victory sent to the khalifa. Internal strife prevented the new negus of Abyssinia from prosecuting the war, which thus, in spite of the Abyssinian success, resulted in the increased prestige of the khalifa. From this time, however, the dervishes ceased to trouble the Abyssinians.

Darfur and Kordofan.—On the outbreak of the mahdi's rebellion Slatin Bey was governor of the province, and mahdism spread over Darfur in spite of Slatin's efforts to stay it. He fought no fewer than 27 actions in various parts of his province, but his own troops became infected with the new faith and deserted him. He was obliged to surrender in Dec. 1883, and was a prisoner until he escaped from Omdurman in 1895. After successive wars between rival amirs, in 1888, the Darfurian chiefs allied themselves with Abu Gemaiza, sheikh of the Masalit Arabs, who had proclaimed himself "Khalifa Osman," and was known as the anti-mahdi. The revolt assumed large proportions, and became the more dangerous to Abdullah, the khalifa, by reason of its religious character. Abu Gemaiza won two important victories, but instead of following them up, he retired to Dar Tama to augment his army, to which thousands flocked as the news of his achievements spread far and wide. He again advanced in Feb. 1889, but was seized with smallpox. After his death, and the subsequent defeat of his army the movement collapsed.

The Bahr el Ghazal. The first outbreak in favour of the mahdi in the Bahr el Ghazal took place in Aug. 1883, and although suppressed by Lupton Bey, a fresh outbreak a year later forced him to retire to Dem Suliman, where he was completely cut off from Khartoum. After gallantly fighting for 18 months he was compelled by the defection of his troops to surrender to Karamalla, the dervish amir of the province, and he died at Omdurman in 1888. In 1890 the Shilluks in the neighbourhood of Fashoda rose against the khalifa, and the dervish amir of Galiabat, Zeki Tumal, was engaged for two years in suppressing the rebellion. In 1892 he was recalled by the khalifa to invade Eritrea (Italian), and on reporting it to be impossible he was summoned to Omdurman and put to death. The country then relapsed into its original barbarous condition, and dervish influence was nominal only.

Equatoria.—In the Equatorial Province, which extended from the Albert Nyanza to Lado, Emin Bey, who had a force of 1,300 Egyptian troops and 3,000 irregulars, distributed among many stations, held out, hoping for reinforcements. In April 1885, however, Karamalla arrived near Lado, the capital, and sent to inform Emin of the fall of Khartoum. Emin and Capt. Casati, an Italian, moved south to Wadelai, and opened friendly relations with the king of Unyoro. Emin determined to remain rather than leave the country and to "hold together, as long as possible, the remnant of the last ten years." His troops were in a mutinous state, wishing to go north rather than south, and unsuccessfully endeavoured to carry him with them by force.

His communications to Europe through Zanzibar led to the relief expedition under Stanley, which went to his rescue by way of the Congo in 1887, and eventually met with Emin and Casati at Nsabé, on the Albert Nyanza, on April 29, 1888. Stanley went back in May to pick up his belated rearguard, leaving Mounteney Jephson and a small escort to accompany Emin round his province. But a revolt broke out, headed by Fadl-el-Maula, governor of Fabbo, and Emin and Jephson were made prisoners by the Egyptian mutineers. In the meantime, the arrival of Stanley at Lake Albert had caused rumours, which quickly spread to Omdurman, of a great invading white pasha, with the result that in July the khalifa sent up the river three steamers and six barges, containing 4,000 troops, to oppose this new-comer. In October the mahdist commander took Rejaf and sent messengers to Dufile to summon Emin to surrender. The mutineers then released Emin and Jephson—who rejoined Stanley and reached Zanzibar safely—and turned to repulse the dervishes, eventually driving them back to Rejaf. They did not, however, follow up their victory. In 1893 Fadl-el-Maula Bey and many of his men took service with the Congo State expedition. The bey was killed fighting the dervishes and the remnant of his men were found by Capt. Thruston from Uganda in March 1894 at Mahagi, on the Albert Nyanza, whither they had drifted in search of supplies. They were enlisted by Thruston and brought back under the British flag to Uganda. In consequence of the Franco-Congolese Treaty of 1894, Maj. Cunningham and Lieut. Vandeleur were sent from Uganda to Dufile, where they planted the British flag on Jan. 15, 1895.

SUDAN CAMPAIGNS, 1896–1900

Accounts of the wonderful progress which Egypt had made during British occupation, notably Sir Alfred Milner's *England in Egypt* (1892), together with the revelation of the character of the khalifa's despotism in the Sudan and the miserable condition of his misgoverned people made by Father Ohrwalder and Slatin Bey after their escape from captivity at Omdurman, stirred public opinion in Great Britain, and brought the question of the recovery of the Sudan into prominence. A change of ministry took place in 1895, and Lord Salisbury's cabinet, which had consistently assailed the Egyptian policy of the old, was not unwilling to consider whether the flourishing and settled condition of Egypt, with a capable little army ready to hand, warranted an attempt to recover gradually the Sudan provinces abandoned by Egypt in 1885 on the advice of Mr. Gladstone's Government. Such being the condition of public and official sentiment, the crushing defeat of the Italians by the Abyssinians at the battle of Adowa on March 1, 1896, and the critical state of Kassala—held by Italy at British suggestion and now closely invested by the dervishes—made it not only desirable but necessary to take immediate action.

On March 14, 1896, Maj.-gen. Sir H. Kitchener, who had succeeded Sir Francis Grenfell as sirdar of the Egyptian army, received orders to reoccupy Akasha, 50m. S. of Sarras, and to carry the railway on there. Subsequent operations were to depend upon the amount of resistance he encountered. The advance to Akasha, occupied on March 20, was followed by and contributed to an easing of the pressure at Kassala, for Osman Digna took part of his investing force for an abortive move toward Suakin. Concentrating at Akasha on June 6 Kitchener moved to the attack of Firket 16m. away, where the amir Hamuda was encamped. The attack was made in two columns: one marching along the river-bank, approached Firket from the north; while the other making a detour through the desert, approached it from the south. The co-operation of the two columns was admirably timed, and on the morning of the 7th the dervish camp was surrounded, and, after a sharp fight half their force was destroyed and the rest dispersed. The dash and discipline of the Egyptian troops in this victory were a good augury for the future. The railway was then pushed forward to Kosha and in September Kitchener made a fresh spring. Dongola was bombarded by the gunboats and captured by the army on the 23rd. The pursuit was pressed until the dervish Dongola army had practically ceased to exist. With the province recovered for Egypt, the work of consolidation began, and preparations were made for a farther advance.

The railway up the right bank of the Nile was continued to Kerma, in order to evade the difficulties of the 3rd cataract; but the sirdar had conceived the bold project of cutting off the great angle of the Nile from Wadi Halfa to Abu Hamed, involving nearly 600m. of navigation and including the 4th cataract, by constructing a railway across the Nubian desert, and so bringing his base at Wadi Halfa within a few hours of his force, when it should have advanced to Abu Hamed, instead of ten days. Early in 1897 this new line of railway was commenced from Wadi Halfa across the great Nubian desert 230m. to Abu Hamed. By July it had advanced 130m. into the desert towards Abu Hamed, when it became necessary, before it was carried farther, to secure that terminus by an advance from Merawi.

In the meantime the khalifa was not idle. He brought to Omdurman the army of the west under Mahmud—some 10,000 men; entrusted the line of the Atbara to Osman Digna; constructed defences in the Shabluka gorge; and personally superintended the organization and drill of the forces gathered at Omdurman, and the collection of a vast reserve of supplies. On July 29 Maj.-gen. Hunter, with a flying column, marched up the Nile from near Merawi to Abu Hamed, 133m. distant. He arrived on Aug. 7 and captured it by storm. By the end of the month the gunboats had surmounted the 4th cataract and reached Abu Hamed. Berber was next occupied, and a reconnoitring raid made thence on Adarama. The railway reached Abu Hamed on Nov. 4, and was pushed rapidly forward along the right bank of the Nile towards Berber.

The forces of the khalifa remaining quiet, the sirdar visited Kassala and negotiated with the willing Italians for its restoration to Egypt. An Egyptian force from Suakin took it formally over on Christmas day 1897. On his return to Berber the sirdar received information of an intended advance of the khalifa northward. He at once ordered a concentration of Egyptian troops towards Berber, and telegraphed to Cairo for a British brigade. Disagreement among the khalifa's generals postponed the dervish advance and gave Kitchener much-needed time. But at the end of February, Mahmud crossed the Nile to Shendi with some 12,000 fighting men, and with Osman Digna advanced along the right bank of the Nile to Aliab, where he struck across the desert to Nakheila, on the Atbara, intending to turn Kitchener's left flank at Berber. The sirdar took up a position at Ras el Hudi, on the Atbara. His force consisted of Gatacre's British brigade and Hunter's Egyptian division, with cavalry, a camel corps and artillery. The dervish army reached Nakheila on March 20, and entrenched themselves. It was ascertained from prisoners that Mahmud's army

was short of provisions and Kitchener therefore did not hurry. He sent his flotilla up the Nile and captured Shendi, the dervish depot, on March 27. On April 4 he advanced and, taking the precaution to construct a strong zariba on the night of the 7th he marched to the attack of Mahmud's zariba, which, after an hour's bombardment in the morning was stormed with complete success. Mahmud was captured with several hundred of his men, and 3,000 were killed. The sirdar lost 80 killed.

Preparations were now made for the attack on the khalifa's force at Omdurman, and the railway carried on to the Atbara. Reinforcements were forwarded from Cairo, including a second British brigade; and on Aug. 24 nearly 26,000 men were concentrated for the advance at Wad Hamad. Kitchener's advance up the west bank of the Nile met with no opposition; and on Sept. 1 the army bivouacked in zariba at Egeiga within four miles of Omdurman. Here, on the next morning the khalifa's army, 40,000 strong, attacked the zariba, but was repulsed. Kitchener then moved out and marched towards Omdurman, when he was again twice fiercely attacked on the right flank and rear, MacDonald's brigade bearing the brunt. MacDonald distinguished himself by his tactics, and completely repulsed the enemy. The 21st Lancers gallantly charged a body of 2,000 dervishes which was unexpectedly met in a khor on the left flank, and drove them westward. The khalifa was now in full retreat, and the sirdar, sending his cavalry in pursuit, marched into Omdurman. The dervish loss was over 10,000 killed, as many wounded, and 5,000 prisoners. The British and Egyptian casualties together were under 500. The European prisoners found in Omdurman were released and a short service held in memory of Gen. Gordon, near the place where he met his death. For the plan of the battle, *see* OMDURMAN.

The results of the battle of Omdurman were the practical destruction of the khalifa's army, the extinction of mahdism in the Sudan, and the recovery of nearly all the country formerly under Egyptian authority. The khalifa fled to Kordofan. The British troops were quickly sent down stream to Cairo, and the sirdar, shortly afterwards created Lord Kitchener of Khartoum, was free to turn his attention to restoring order in the country.

He had first, however, to deal with a serious development—the arrival of a French expedition at Fashoda, on the White Nile, some 600m. above Khartoum. He started for the south on Sept. 10 with five gunboats and a small force, and on the 19th arrived at Fashoda, to find the French Capt. Marchand, with 120 Senegalese soldiers, entrenched there and the French flag flying. He arranged with Marchand to leave the political question to be settled by diplomacy, and contented himself with hoisting the British and Egyptian flags to the south of the French flag leaving a gunboat and a Sudanese battalion to guard them. The French expedition had experienced great difficulties on its way, and at Fashoda had been attacked by a dervish force on Aug. 25, and was anticipating another when Kitchener arrived and probably saved it from destruction. The Fashoda incident was the subject of important diplomatic negotiations, which at one time approached an acute phase; but ultimately the French position was found to be untenable, and on Dec. 11 Marchand and his men returned to France by the Sobat, Abyssinia and Jibuti. In the following March the spheres of interest of Great Britain and France in the Nile basin were defined by a declaration making an addition to Article IV. of the Niger convention of the previous year.

During the sirdar's absence from Omdurman Col. Hunter commanded an expedition up the Blue Nile, establishing garrisons, and Col. Parsons had marched with 1,400 men from Kassala to capture Gedaref. He encountered 4,000 dervishes outside the town, and after a desperate fight, defeated them. At Gedaref he was assailed by Ahmed Fedil, but the latter moved south on the approach of reinforcements, only to be caught and cut up in crossing the Blue Nile at Dukheila. Early in 1899 a reconnaissance in force under Col. Walter Kitchener was conducted against the khalifa, but found him strongly posted in Kordofan. However, towards the end of the year when order having been established throughout the rest of the Sudan, it was decided to move against Kordofan.

A strong expedition in October failed to pin the khalifa, but next month a flying column of 3,700 men under Col. Wingate was concentrated at Faki Kohi. On reaching Gedid the khalifa was ascertained to be at Om Debreikat. Wingate marched at midnight of the 24th, and was resting his troops on high ground in front of the khalifa's position, when at daybreak the dervishes attacked. They were repulsed with great slaughter, and Wingate advancing carried the camp. The khalifa, unable to rally his men, gathered many of his principal amirs around him, and they met their death unflinchingly from the bullets of the advancing Sudanese infantry. Three thousand men and 29 amirs of importance, including the khalifa's eldest son and intended successor, surrendered. The dervish loss in the two actions was estimated at 1,000 killed and wounded, while the Egyptian casualties were only 4 killed and 29 wounded. Thus ended the power of the khalifa and of mahdism.

On Jan. 19, 1900, Osman Digna, who had been so great a supporter of mahdism in the Eastern Sudan, and had always shown great discretion in securing the safety of his own person, was surrounded and captured among the hills beyond Tokar. He died in captivity at Wady Halfa on Dec. 8, 1926, aged 85. The reconquest of Dongola and the Sudan provinces during the three years from March 1896 to Dec. 1898 was achieved at an unprecedentedly small cost, while the main item of expenditure—the railway—has remained a permanent benefit to the country. The figures were:—

Railways	£E. 1,181,372
Telegraphs	21,825
Gunboats	154,934
Military	996,223
Total	£E. 2,354,354

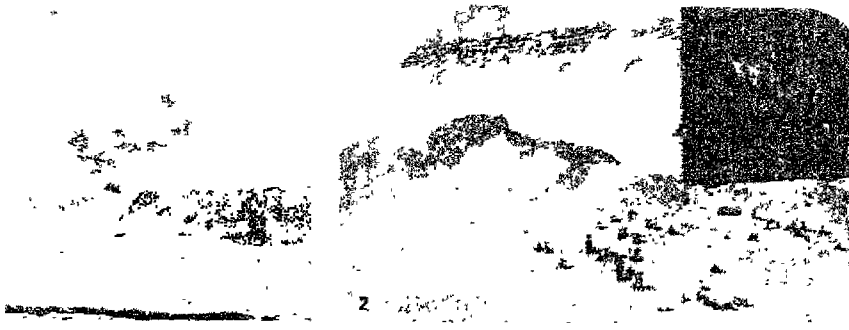
Towards this expense the British Government gave a grant-in-aid of £800,000, and the balance was born by the Egyptian treasury.

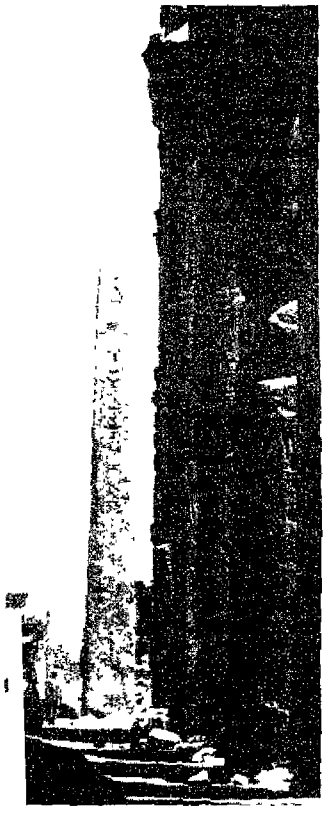
(X.)

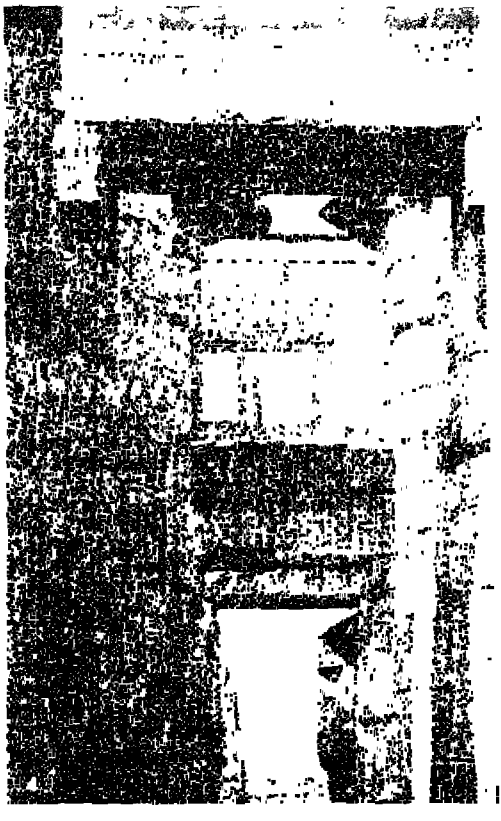
EGYPTIAN ARCHITECTURE. The architecture of ancient Egypt is a primary contribution to world architecture. Its methods of construction were so essentially simple and its material for monumental work so imperishable, that its survival is unique. The modern designer has much to learn from the severity and grandeur of its masses, its treatments of broad planes and the sculpturesque qualities of its highest manifestations. Some of its monumental work was rock-cut, but most of it was built with enormous masses of stone or granite, set with the utmost nicety and care and worked to the finest possible surface. Egyptian architecture was perfectly suited to its natural environment—the sandy desert adjacent to the Nile. It was of the simplest possible form: the arch or vault was not used, except with crude brick, in subsidiary positions and constructed in a manner that produced the minimum of risk. It is clear, however, that the principle of the true arch was understood. There is no other instance in the world's history of a prevailing type of structure persisting, comparatively unchanged, for such a long period of time. Emerging, probably from the East, over 3,000 years before our era, its principal forms have stamped themselves indelibly on the consciousness of mankind. Even the dominance of Rome failed to make any permanent impression; and it was only when Rome ceased to exploit a province that had no political significance that these forms became extinct.

Pyramids and Mastabas.—The vast superstructures which the early kings erected to enclose their tombs are characteristically Egyptian. Though they belong more to engineering than architecture, there is no doubt about the impressiveness and grandeur of the largest examples. In the stepped pyramid of Medum, the result is truly architectonic. The slopes are so steep that they nearly resemble walls and have real monumental quality. At Sakkara, near Cairo, the oldest or stepped pyramid has a resemblance to the ziggurat form of Mesopotamia. Both forms [illegible] ideals, are believed to be attempts to make mountains rise from plains.[1] The lower stage of the Medum pyramid is finished and the intention may have been one unbroken square cone. It is probable that the Sakkara pyra-

[1](W. R. Lethaby, quoting from Zeus, vol. iii., by A. B. Cook, in the *Builder* magazine, for April 6, 1928.)



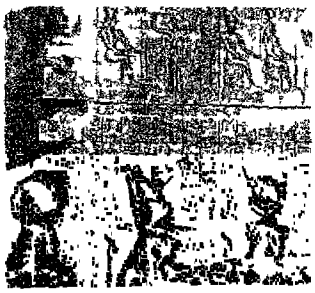




HE BRITISH MUSEUM, (2) PROFESSOR FLINDERS PETRIE, (5, 6) CECIL M. PIRTH

EXAMPLES OF EGYPTIAN ARCHITECTURE

ops at Gizeh 4th dynasty, *c.* 2900 south of Cairo. Built by Snefru Rs M dd e Egypt, obe sk rnak show ng c eratory B lt by Seti I. and Rameses II. 5. Chapel, Sakkara, near Giz 3000 B.C Fl'ted columns resemb'e Grtek Dor'c 6 at one end of pyram d enc osu e c 3000 B C



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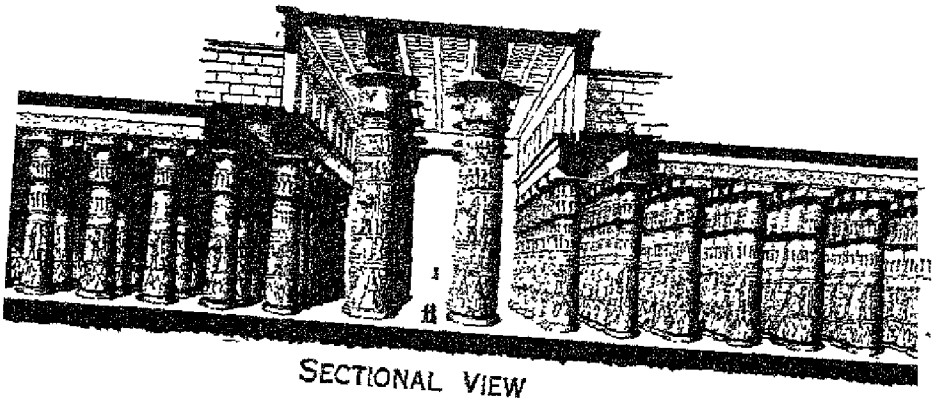
6

(1, 2, 4, 5) THE TRUSTEES OF THE BRITISH MUSEUM. (3, 6) THE EGYPT EXPLORATION SOCIETY

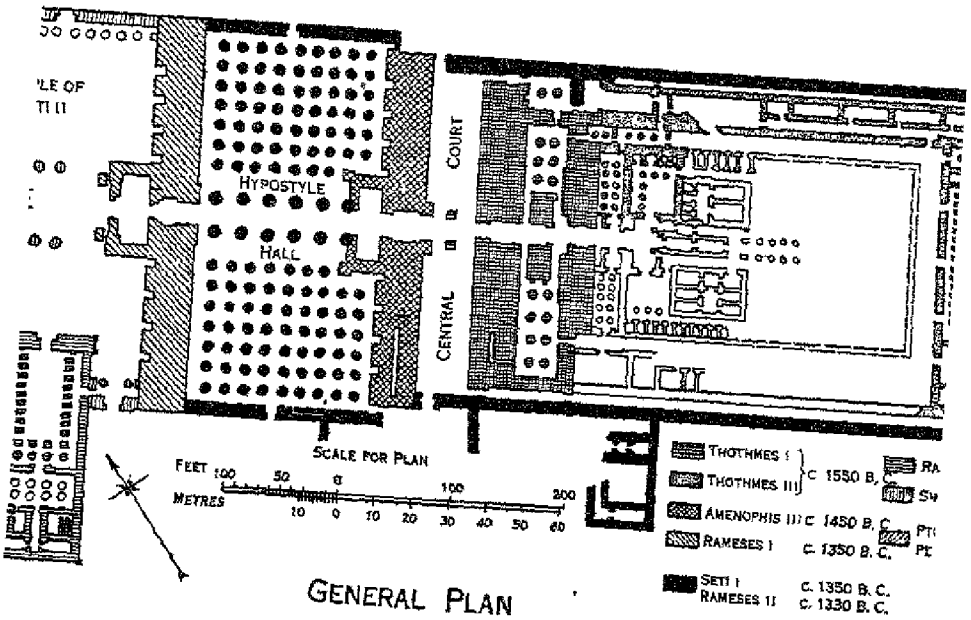
DETAILS OF EGYPTIAN TEMPLES

1 Great Temple, Abu Simbel, formed by Rameses II., c. 1270 B.C. 2 South wall, Temple of Hathor, Denderah, built by Cleopatra VI., 58 B.C. 3 Carvings and inscription on Temple of Seti I.—at Abydos, c. 1300 B.C. 4. Temple, Kalabsheh Upper Egypt Capitals, Roman period, 1st century A.D. 5. Out 58 B.C. 6 Temple of Hats Senmut, c 1500 B.C

EGYPTIAN ARCHITECTURE



SECTIONAL VIEW
OF
HYPOSTYLE HALL



GENERAL PLAN
OF THE
GREAT TEMPLE

CHER, "HISTORY OF ARCHITECTURE ON THE COMPARATIVE METHOD," EIGHTH EDITION, 1926 (BATSFORD)

THE GREAT TEMPLE AT KARNAK

le steps represent under-construction. at Ghizeh were finished with smooth ts in places. The pure conical form nce, though the existing surfaces, for ugh steps of large size. The various ie interior of the great pyramid show the handling of material. There is no agnitude and finish at such an early servative estimate, it can hardly be yramids were, for the most part, the ourth dynasty. Mastabas were built m with sloping walls containing tomb revents them from being really im- the earlier form for those of royal d pyramid may be a succession of the other. The mastabas in the great important because of their internal

Rock-cut Tombs and Monuments.—In s of the 12th dynasty (*c.* 2000 B.C.) at Beni Egypt, pillars are finely used and some of the One of these tombs has a front with a strong r on the surface only—to Greek Doric work c later. The grandest expression of rock-cut t the two 19th dynasty temples at Abu Simbe Upper Nile, which are both works of Rame greatest builders of all time. In the great te sloping plane of sandstone rock relieved by figures, 70 ft. high, as guardians, deeply cut ou a background which is nearly vertical. In the natural slope, worked to a true surface, form figures are deeply incised, forming long panels temple of Queen Hatshepsut, at Deir-el-Bah rock-cut, as the natural rock, rising to a great h ert, forms a background to a long built front continuous lintel treated with the utmost sim

the architectural forms carry weight and seem part of the cliff face behind them: any ornament would have destroyed this effect. Complete balance is thereby secured by the great forecourt treatments of the approach, which very successfully counteract any crushing effect from the cliff by introducing an immense base area.

Temples.—The free standing temple is the ultimate expression of Egyptian form and is, in the truest sense, monumental. A great deal is made of the approach. An avenue formed by two rows of sphinxes facing inwards—and in one case 330 yd long—is associated with an outer portal called the propylon. This feature consists of two towers with sloping walls, connected by a smaller gateway. Beyond this is the outer court of the temple proper which is enclosed by walls or colonnades. At the temple entrance is another pylon gateway, resembling the propylon in its treatment. The temple itself is a series of halls which gradually diminish in size and height until the inner sanctuary is reached; one main axial line controls the whole. The arrangement indicated is a typical one based on several examples of the 18th and 19th dynasties at Karnak, in Middle Egypt. The grandest part of this complete arrangement was its first or "hypostyle" hall, containing a forest of columns cut through by a central avenue of large columns on the main axis. The hypostyle hall of the great 19th dynasty temple at Karnak is one of the architectural achievements of the world. Substantial fragments of it remain but as all its roofing slabs have gone it is difficult to realize its true effect. Of tremendous scale, containing 134 columns, its internal dimensions are 329 ft by 170 ft., while the columns of its central avenue are 70 ft. high. We have more complete knowledge about the lighting of this hall than we have about the lighting of any Greek temple. The extra height of the central avenue enabled a clerestory, or vertical arrangement of top lighting, to be formed. This consisted of large rectangular openings filled with pierced stone trellises, raised above the normal roof level. We see here distinct prototypes of the Roman basilicas and of the mediaeval cathedral churches which followed on from them.

The great temple at Edfu—which, though of "Ptolemaic" or Graeco-Roman times, contains all the unchanging elements of Egyptian architectural form—is very well preserved. The dignity of unbroken wall surface built to a slight slope and of immense mass in association with pylons in almost perfect preservation, can be seen there to perfection. The effect of the whole is rendered much more impressive by the all-over decoration of incised figures arranged in tiers. Taken as a whole, perhaps the most impressive building in Egypt at the present day is the 19th dynasty temple of Seti I. at Abydos, which is of peculiar plan, as its arrangement was dependent on nine shrines placed in a row, one of them dedicated to Seti himself. It is in a remarkable state of preservation and an adequate idea can be formed of the value of rooms of great size containing their ceilings, doorways and decorative treatments, almost intact. No building illustrates more clearly what Egyptian architectural form really meant in these comparatively simple elements of expression. It is a lesson in the use of form and in the richness that can be obtained by an all-over method of decorating with delicate relief and colour controlled by simple lines. These facts should give it peculiar value to modern designers and decorators. The Ptolemaic temple of Hathor at Denderah, though coarse in detail, is also a valuable example because of its completeness. This building practically exists now as it was built, so that the effect of a stone flat-roofed structure can be realized both externally and internally.

Columns, Pillars, Obelisks and Domestic Work.—Columns and pillars have an important function in all early styles and Egyptian architecture is no exception. The character of the Egyptian column was distinctive and peculiar in most of its many forms, persisting for some 3,000 years. It usually suggests natural growth: as a grouped collection of budding or flowering stalks, bound together at the base and near the top of the shaft; and it is decorated to enforce this suggestion. Circular columns discovered recently at Sakkara, by Firth, show a remarkable approximation to pure Greek Doric ones of the fifth century B.C.; and as the Egyptian ones are ascribed to the third dynasty and must have been executed about 3000 B.C., they are of great significance in the history of art. The pillar is essentially a square and not a round support. Plain square pillars can be seen in the "granite temple" at Ghizeh but many-sided ones, cut out of square, are more usual. This principle is sometimes carried so far that the effect of circular columns is obtained, as in the tomb at Beni Hassan, already cited. Some pillars at the temple of Seti I Abydos, have shallow flutings, with a plain inscribed strip on each of the four cardinal faces. Egyptian pillars are more suggestive of Indian forms than of the Aegean or Greek ones. They often have fine sculpturesque quality and could be used appropriately in the concrete constructions of to-day.

The obelisk is an Egyptian form of commemorative pillar which has survived into Renaissance and modern times. It is akin to the inscribed pillars of the Sumerians in Chaldea and had, probably, some special religious significance. It is peculiarly suited to its surroundings as used in Egypt and has great monumental value in certain positions. The earliest examples date from the 11th dynasty. Senmut used obelisks in the temple at Deir el Bahari.

Domestic buildings have, of course, completely disappeared but we know from painted representations that some of them were treated with great delicacy and fine decorative quality, suggestive of a kind of pole and curtain construction. There is a slight but graceful cornice of the prevailing type and, obviously, a flat roof. This form of structure may well have influenced Pompeian decoration.

Ornament.—It is customary to regard Egyptian building as destitute of any but the simplest mouldings; what is known as the "gorge"—or overhanging hollow moulding—with a plain roll member beneath it which was also carried down the external angles of the walls and doorways, being accepted as practically the only mouldings used. It is true that these, based on natural forms, were universal and were used for every kind of cornice and crowning member. Nevertheless, there is a considerable feeling of moulded form in many of the columns. Apart from mouldings the ornamental form of many of the spreading capitals is most pronounced and constitutes a definite emphasis which amounts, in places, to richness. Of other architectural enrichment there is really only one form but it is a most effective one—the winged solar disc, which was used over doorways and pylons in the hollow of the cornice.

Sculpture.—The sculpture of ancient Egypt is justly famous for its qualities of extreme simplicity and grandeur and some of the finest examples are truly architectonic. In this category are the maneless lions of red granite, now in the British Museum, belonging to the reign of Tutankhamen in the 18th dynasty. The nobility of animal form in repose has never been conveyed with greater truth and absence of superfluous detail. The seated figures at Abu Simbel are even more pronouncedly architectonic and show the same mastery. The celebrated sphinx, of doubtful date, near the pyramids of Ghizeh, is a colossal *tour-de-force* of sculpture, which, from its size, constitutes a monument; in a lesser degree the seated colossi of the Theban plain are in the same category. Less successful, because coarser in detail, are the pillared supports in the form of human figures in the Ramesseum at Thebes and the human-headed capitals with four faces from the Hathor columns in the temple at Denderah. The avenue of ram-headed sphinxes at Karnak is an example of emphasis by reiteration, and must have impressed those approaching the temple with a feeling of mystery and awe: but like all other things in Egyptian sculpture, they were rendered with monumental calm.

Surface Decoration.—If pronounced sculpture in the round was of considerable architectonic value, it was overshadowed in that respect by the relief sculpture and incised work which were the prevailing forms of wall decoration in all periods. To decorate walls with any completeness, there must be subject material and, like other races of the early world, the Egyptians were at no loss in this respect. With a thoroughness which has never been excelled, they carved on their wall surfaces the intricate systems connected with their worship of the dead as well as the ceremonies and observances of their life on earth. At its best it is neither

sculpture nor painted decoration to both of these combined. Nowhere is it seen to greater advantage than as at Abydos in the [illegible] one which was capable of taking the most delicate render. In the dry climate of Egypt, parts of the painted finish seem as fresh to-day as when they were executed. The method is one of incision as well as relief in which the grades of sharpness in definition were treated with amazing skill. Even in granite this system prevailed, combined with the simpler incised work of symbols and hieroglyphics, the schematic material being grouped by means of incised lines and delicate bands. The decoration travels round doorways and enhances their value by a skilful arrangement of shallow panels emphasizing posts and lintels. Nothing could be more complete and, in its way, more successful. The Hindu decorated by serried ranks of figures in relief; the Assyrian by delicate reliefs in fine stone or alabaster; the Greek by a restrained scheme of friezes; but nothing at once so comprehensive and so architectonic as the finest Egyptian decoration has ever been produced. It is an all-over principle which even includes columns without interfering with their sense of structural stability.

At a certain brief period in Egyptian art—that of the ill-fated Akhenaton (Ikhnaton, *q.v.*) of the 18th dynasty—an extraordinary development in painted plaster decoration occurred, which was contemporary with and doubtless influenced by somewhat similar work in late Minoan Crete. The floors of Akhenaton's palace at Tel-el-Amarna were covered with this plaster, for the most part representing Nilotic plants and birds arranged in large panels with an astonishing richness and variety of detail. *See* EGYPT, ART AND ARCHAEOLOGY.

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EGYPTIAN LANGUAGE. The documents for the history of the Egyptian language begin with the primitive inscriptions of the 1st dynasty (not later than 3,300 B.C.) and end with the latest Coptic compositions of about the 14th century A.D. The bulk of the hieroglyphic inscriptions are written in a more or less artificial literary language; but in business documents, letters, popular tales, etc., the scribes often approached more closely to the living form of the tongue, and thus reveal its progressive changes. The stages of the language may be distinguished as follows:

Old Egyptian.—In this, the language of the Old Kingdom, we have (*a*) inscriptions of the 1st dynasty, too brief and concise to throw much light on the language of that time; and the great collections of spells and ritual texts found inscribed in the Pyramids of the 5th and 6th dynasties, which must even then have been of high antiquity, though they contain later additions made in the same style; (*b*) a few historical texts and an abundance of short inscriptions representing the language of the 4th, 5th and 6th dynasties. The ordinary *literary language* of the later monuments, sometimes termed classical or Middle Egyptian, is modelled on Old-Middle Egyptian, but often much affected by contemporary speech.

Middle and New Egyptian.—These represent the vulgar speech of the Middle and New Kingdoms respectively. The former is found chiefly in tales, letters, etc., written in hieratic on papyri of the 13th dynasty to the end of the Middle Kingdom; also in some inscriptions of the 18th dynasty. New Egyptian is seen in hieratic papyri from the end of the 18th to the 21st dynasties. The spelling of New Egyptian is full of false etymologies, otiose signs, etc., the old orthography being quite unable to adapt itself neatly to the profoundly modified language; nevertheless, this clumsy spelling is expressive, and the very mistakes are instructive as to the pronunciation.

Demotic (*q.v.*).—Demotic Egyptian seems to represent approximately the vulgar speech of the Saite period during which the demotic writing was formed. With progressive changes, this form of the language is found in documents reaching down to the fall of paganism in the 4th century A.D. and a century longer at Philae.

Coptic (*q.v.*).—This was the vulgar speech of about the 3rd- [illegible] century [illegible] and was written in Greek characters; several dialects being easily distinguished in it.

The above stages of the Egyptian language are not abruptly defined. Progress is traceable from dynasty to dynasty or from century to century but the gap between Middle Egyptian and Old Egyptian is wide. New Egyptian shades off almost imperceptibly into demotic, and gaps which now exist in the development may be filled by further discovery. Coptic is the only stage of the language in which the spelling gives a clear idea of the pronunciation. It is therefore the mainstay of the scholar in investigating or restoring the word-forms of the ancient language. Greek transcriptions of Egyptian names and words are valuable as evidence for the vocalization of Egyptian. Such are found from the 6th century B.C. in the inscription of Abu Simbel, from the 5th in Herodotus, etc., and abound in Ptolemaic and later documents from the beginning of the 3rd century B.C. onwards. At first sight they may seem inaccurate, but on closer examination the Graecizing is seen to follow definite rules, especially in the Ptolemaic period. Aramaic transcriptions of the 4th and 5th centuries B.C., and earlier ones in biblical Hebrew, are very useful for revealing the true condition of the consonantal skeletons of words, but cuneiform gives us valuable examples of vocalization as early as the 25th, 19th and 18th dynasties reaching to the 15th century B.C.

It must not be supposed that the pronunciation of Old Egyptian can be restored from Coptic. In the latter speech, Old Egyptian verbal forms are mostly replaced by periphrases; though the strong roots are often preserved entire, the weaker consonants and the y have largely or entirely disappeared, so that the language appears as one of biliteral rather than triliteral roots. Coptic is strongly impregnated with Greek words adopted late; moreover, a certain number of Semitic loan-words flowed into Egyptian at all ages, and especially from the 16th century B.C. onwards, displacing earlier words. Demotic grammar ought soon to be thoroughly comprehensible in its forms, and the study of Late Egyptian should not stand far behind that of demotic. On the other hand, Middle Egyptian, and still more Old Egyptian, which is separated from Middle Egyptian by a wide gap, will perhaps always be to us little more than consonantal skeletons, the flesh and blood of their vocalization being for the most part irretrievably lost.

In common with the Semitic languages, the Berber languages of North Africa, and the Cushite language of north-east Africa, Egyptian of all periods possesses grammatical gender, expressing masculine and feminine. Remarkable resemblances have been observed in the grammatical structure of the Berber and Cushite groups with Semitic (*cf.* H. Zimmern, *Vergleichende Grammatik d. semitischen Sprachen*, Berlin, 1898, especially pronouns and verbs). Their connection with Semitic and Egyptian remains at present an obscure though probable hypothesis. On the other hand, Egyptian in its oldest form is clearly related to Semitic. In it triliteral roots enormously preponderate; the roots consist of consonants and semi-consonants only, inflexion being effected by internal vowel change and the addition of certain consonants or vowels at the beginning or end. In the verb there is a precise analogue of the Semitic perfect. In nouns the feminine is formed by the addition of *t*, the adjective by the addition of *y*, instrumental nouns and some others (participial, etc.) by prefixing *m*, and both numerals and personal pronouns show obvious relationship. Although the vocabularies in general are widely different, Egyptian either was originally a characteristic member of the Semitic family of languages, greatly modified in its African surroundings or was the result of fusion between an African and a Semitic tongue or tongues.

The verb in the earliest known form of Egyptian had displaced the Semitic imperfect, and the perfect largely by new suffix-tenses derived from a participle with pronoun such as *sdm-f* "hearing he (is)," = "he hears," *sdm n-f* "heard (is) to him" = he has heard. The few forms were past and present but with all the vagueness of the Semitic forms and more. Coptic presents a remarkable contrast to Egyptian in the preciseness of its periphrastic conjugation. There are two present tenses, an imperfect, two perfects, a pluperfect; a present and three futures besides future per

tect; there are also conjunctive and emphatic forms. The negatives of some of these are expressed by special prefixes. The gradual growth of these new forms can be traced through all the stages of Egyptian. Throughout the history of the language we note an increasing tendency to periphrasis; but there was no great advance towards *precision* before demotic. In demotic there are distinguishable a present tense, imperfect, perfect, frequentative, future, future perfect, conjunctive and optative; also present, past and future negative, etc. The passive was extinct before demotic: demotic and Coptic express it by an impersonal "they" (e.g. "they struck him" stands for "he was struck."

In other departments besides the verb, the Egyptian language was far better adapted to practical ends during and after the period of the Delmic dynasties (22nd–30th) than before. It was both simplified and enriched. The inflections rapidly disappeared and little was left of the distinctions between masculine and feminine, singular, dual and plural—except in the pronouns. The dual number had been given up entirely at an earlier date. The pronouns, both personal and demonstrative, retained their forms very fully. As prefixes, suffixes and articles, they, together with some auxiliary verbs, provided the principal mechanism of the renovated language. An abundant supply of useful adverbs was gradually accumulated as well as conjunctions, so far as the functions of the latter were not already performed by the verbal prefixes. These improvements in the language correspond to the constant intercourse of all classes of Egyptians with foreigners from Europe and Asia. Probably the best stage of Egyptian speech was that which immediately preceded Coptic. Though Coptic is here and there more exactly expressive than the best demotic, it was spoilt by too much Greek, duplicating and too often expelling native expressions that were already adequate for its simple requirements; it is pleonastic. *See* HIEROGLYPHICS.

For modern Egyptian literature *see* ARABIC LITERATURE.

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EGYPTOLOGY: *see* EGYPT; EGYPTIAN ARCHITECTURE, etc.

EHRENBERG, CHRISTIAN GOTTFRIED (1795–1876), German naturalist, was born at Delitzsch in Saxony on April 19, 1795. After studying at Leipzig and Berlin, where he took the degree of doctor of medicine in 1818, he was appointed professor of medicine in the university of Berlin (1827). Meanwhile in 1820 he was engaged in a scientific exploration conducted by General von Minutoli in Egypt. They travelled in the Libyan desert, the Nile valley and the northern coasts of the Red Sea, and subsequently in Syria, Arabia and Abyssinia. Some results of these travels and of the important collections that had been made were reported on by Humboldt in 1826; and afterwards Ehrenberg produced *Symbolae physicae* (2 vols. 1828–1834), in which many particulars of the mammals, birds, insects, etc., were made public. In 1829 he accompanied Humboldt through eastern Russia to the Chinese frontier. On his return he undertook microscopical researches of the infusorial earths used for polishing and other economic purposes; and of the microscopic organisms of chalk formations, and of the modern marine and fresh-water accumulations. Ehrenberg showed that considerable masses of rock were composed of minute forms of animals or plants. He demonstrated also that marine phosphorescence was due to organisms. He died in Berlin on June 27, 1876.

He wrote also *Die Infusionsthierchen als vollkommene Organismen* (2 vols., Leipzig, 1838); *Mikrogeologie* (1 vols., Leipzig, 1854); and "Fortsetzung der mikrogeologischen Studien," in *Abhandl. der k. Akad. der Wissenschaft* (1875). *See* Lane, *Christian Gottfried Ehrenberg, ein Vertreter deutscher Naturforschung* (1895).

EHRENBREITSTEIN, a town of Germany, in the Prussian Rhine province, on the right bank of the Rhine, facing Coblenz, with which it is connected by a railway bridge and a bridge of boats, on the main line of railway Frankfort-on-Main–Cologne. Pop. (1925) 2,925. Above the town, facing the mouth of the Mosel, on a rock 400 ft. high, lies the magnificent fortress of Ehrenbreitstein. The sides towards the Rhine and the south and south-east are precipitous, and the south side, on which is the [illegible] defended. The central fort or citadel is flanked by a double line of works with three tiers of casemate batteries. The works towards the north and north-east end in a separate outlying fort. The site of the castle is said to have been occupied by a Roman fort built in the time of the emperor Julian. In the 11th century the castle was held by a noble named Erembert, from whom it is said to have derived its name. In the 12th century it came into the possession of Archbishop Hillin (de Fallemagne) of Trier, who strengthened the defences in 1153. These were again extended by Archbishop Henry II. (de Fénétrange) in 1286, and by Archbishop John II. of Baden in 1481. In 1631 it was surrendered by the archbishop elector Philip Christopher von Soetern to the French, but was recovered by the Imperialists in 1637 and given to the archbishop elector of Cologne. It was restored to the elector of Trier in 1650, but was not strongly fortified until 1672. Between this date and 1815, the castle suffered many vicissitudes; it afterwards was reconstructed.

EHRENFELS, CHRISTIAN FREIHERR VON (1859–), Austrian philosopher, was born on June 20, 1859, at Rodaun. Since 1896 he has been professor at Prague. The influence of Brentano and Meinong is apparent in his *System der Werttheorie*, 2 vols. (1897–98) and *Grundbegriffe der Ethik* (1907). His *Sexualethik* (1907) was followed by other works on sex problems. Ehrenfels was also the author of three dramas *Mélusine* (1887), the allegorical *Hildegard* (1895) and *Der Kampf des Prometheus* (1895).

EHRLICH, PAUL (1854–1915), German bacteriologist, was born in Silesia of Jewish parentage. He studied medicine and was early drawn to research on aniline dyes, at the same time winning distinction as a bacteriologist. In 1907 he discovered the dye, known as "trypan red," which, when injected into the blood of animals infected with trypanosomes effected the destruction of these organisms. This led him to try to treat other diseases by chemical injections and culminated in his famous discovery in connection with venereal diseases. It was announced in 1910 that he had prepared an arsenical compound, known as salvarsan or "606," which was a cure for syphilis. The name was given because it was the 606th compound that he had tried for the purpose. Ehrlich also did important work on problems of immunity. In 1908 he shared with Metchnikov the Nobel prize for medicine.

See *Paul Ehrlich: eine Darstellung seines wissenschaftlichen Wirkens* (1914).

EHUD, in the Old Testament, a "judge" who delivered Israel from the Moabites (Judges iii. 12–30), by assassinating Eglon king of Moab, and raising the tribe of Ephraim to seize and hold the fords against the fleeing Moabite garrisons. He is called the son of Gera, a Benjamite, but since Gera and Ehud are tribal names, it has been supposed that this notice is not original. *See* further BENJAMIN, JUDGES.

EIBENSTOCK, a town of Germany, in the republic of Saxony, near the Mulde, on the borders of Bohemia, 17 m. by rail S.S.E. of Zwickau. Pop. (1925) 9,210. It is a principal seat of the tambour embroidery, introduced in 1775 by Clara Angermann, and possesses manufactories of curtains, lace and pasteboard, and tin and iron works. It has also a large cattle market. Eibenstock, together with Schwarzenberg, was acquired by purchase in 1533 by Saxony and was granted municipal rights in 1534.

EICHENDORFF, JOSEPH, FREIHERR VON (1788–1857), German poet and romance-writer, was born at Lubowitz, near Ratibor, in Silesia, on March 10, 1788. He studied law at Halle and Heidelberg from 1805 to 1808. After a visit to Paris he went to Vienna, where he resided until 1813, when he joined the Prussian army as a volunteer in the famous Lützow corps. In 1816 he was appointed to a judicial office at Breslau. He subsequently held similar offices at Danzig, Königsberg and Berlin. Retiring from the public service in 1844, he lived successively in Danzig, Vienna, Dresden and Berlin. He died at Neisse on Nov. 26, 1857. Eichendorff was one of the most distinguished of the later members of the German romantic school. His genius was essentially lyrical. Thus he is most successful in his shorter romances and dramas, where constructive power is in least demand. His first work, written in 1811, was a romance, *Ahnung und Gegenwart*

(1815). This was followed at short intervals by others, the most famous of which is the delightful *Aus dem Leben eines Taugenichts* (1826), which has often been reprinted. Of his dramas may be mentioned *Ezzelin von Romano* (1828), and *Der letzte Held von Marienburg* (1830), both tragedies, and a comedy, *Die Freier* (1833). He also translated several of Calderon's religious dramas (*Geistliche Schauspiele*, 2 vols. 1846–52). It is, however, through his lyrics (*Gedichte*, first collected 1837) that Eichendorff is best known. He is perhaps the greatest lyric poet of the second phase of the Romantic movement. No one has given more beautiful expression than he to the poetry of a wandering life; often, again, his lyrics are exquisite word pictures interpreting the mystic meaning of the moods of nature, as in *Nachts*, or the mystery which haunts the twilight forests and feudal castles of Germany, as in the dramatic lyric *Waldesgespräch* or *Auf einer Burg*. Many of his verses were set to music by Schubert and Schumann.

In his later years Eichendorff published several works on literary history and criticism.

Eichendorff's *Sämtliche Werke* appeared in 6 vols. (1864); a critical edition is that by W. Kosch and A. Sauer (1911 etc.). C. H. von Eichendorff's biographical introduction to the *Sämtliche Werke;* also H. Keiter, *Joseph von Eichendorff* (Cologne, 1887); H. Brandenburg (*Joseph von Eichendorff, sein Leben und sein Schaffen* [Munich 1922]).

EICHHORN, HERMANN VON (1848–1918), German field-marshal, was born at Breslau on Feb. 13, 1848. He took part as a young officer, in the campaigns of 1866 and 1870–71. In 1913 he was appointed inspector-general of the VII. Army inspection at Saarbrücken. At the outbreak of the World War he was incapacitated by an accident, but took part in the battle of Soissons in Jan. 1915. In that month he was appointed to the command of the X. Army, which fought in the battle of the Masurian lakes in February. In August he took Kovno and afterwards the fortresses of Grodno and Olita, and continued his victorious advance into Russia. From 1916 to 1918 Eichhorn was in command of the army group known by his name in Courland. In Dec. 1917 he was raised to the rank of general field-marshal and sent to the Ukraine as chief-in-command of the German troops on the eastern front. He was assassinated at Kiev on July 30, 1918.

EICHHORN, JOHANN GOTTFRIED (1752–1827), German theologian, was born at Dörrenzimmern on Oct. 16, 1752. Eichhorn has been called "the founder of modern Old Testament criticism." He first properly recognized its scope and problems. It was Eichhorn's conclusion that "most of the writings of the Hebrews have passed through several hands," and took for granted that all the so-called supernatural facts relating to the Old and New Testaments were explicable on natural principles. He estimated them from the standpoint of the ancient world, and by the superstitious beliefs which were then generally in vogue, and did not perceive in them any religious ideas of much importance for modern times. He regarded many books of the Old Testament as spurious, questioned the genuineness of *2 Peter* and *Jude*, denied the Pauline authorship of *Timothy* and *Titus*, and suggested that the canonical gospels were based upon various translations and editions of a primary Aramaic gospel.

His principal works were—*Geschichte des Ostindischen Handels vor Mohammed* (Gotha, 1775); *Allgemeine Bibliothek der biblischen Literatur* (10 vols., Leipzig, 1787–1801); *Einleitung in das Alte Testament* (3 vols., Leipzig, 1780–83); *Einleitung in das Neue Testament* (1804–12); *Einleitung in die apokryphischen Bücher des Alten Testaments* (Gött., 1795); *Commentarius in apocalypsin Joannis* (2 vols., Gott., 1791); *Die Hebr. Propheten* (3 vols., Gött., 1816–19); *Allgemeine Geschichte der Cultur und Literatur des neuern Europa* (2 vols., Gött., 1796–99); *Literärgeschichte* (2 vols., Gött., 1799–1814); *Geschichte der Literatur von ihrem Anfange bis auf die neuesten Zeiten* (5 vols., Gött., 1805–12); *Übersicht der Französischen Revolution* (2 vols., Gött., 1797); *Weltgeschichte* (3rd ed., 5 vols., Gött., 1819–20); *Geschichte der drei letzten Jahrhunderte* (3rd ed., 6 vols., Hanover, 1817–18); *Urgeschichte des erlauchten Hauses der Welfen* (Hanover, 1817).

See R. W. Mackay, *The Tübingen School and its Antecedents* (1863); O. Pfleiderer, *Development of Theology* (1890), T. K. Cheyne, *Founders of Old Testament Criticism* (1893).

EICHHORN, KARL FRIEDRICH (1781–1854), German jurist, son of the p g born at Jena on Nov 20 1781 was professor of law at Frankfurt-on-Oder, Berlin, and Göttingen successively. He died at Cologne on July 4, 1854. Eichhorn is regarded as one of the principal authorities on German constitutional law. His chief work is *Deutsche Staats- und Rechtsgeschichte* (Göttingen, 1808–1823, 5th ed. 1843–1844). In company with Savigny and J. F. L. Göschen he founded the *Zeitschrift für geschichtliche Rechtswissenschaft*.

See Schulte, *Karl Friedrich Eichhorn, sein Leben und Wirken* (1884).

EICHSTÄTT, a town and episcopal see of Germany, in the republic of Bavaria, in the valley of the Altmühl, 35 m. S. of Nuremberg, on the railway to Ingolstadt and Munich. Pop. (1925) 8,006. The cathedral of St. Wilibald (first bishop of Eichstätt)—with the tomb of the saint and numerous pictures and relics,—the church of St. Walpurgis, sister of Wilibald, whose remains rest in the choir, and the Capuchin church, a copy of the Holy Sepulchre are the chief churches. Of its secular buildings the most noticeable are the town hall and the Leuchtenberg palace, once the residence of the prince bishops and later of the dukes of Leuchtenberg (now occupied by the court of justice of the district). The Wilibaldsburg, built on a neighbouring hill in the 14th century by Bishop Bertold of Hohenzollern, was long the residence of the prince bishops of Eichstätt, and now contains an historical museum. The industries of the town include bootmaking, brewing and the production of lithographic stones.

Eichstätt (Lat. *Aureatum* or *Rubilocus*) was originally a Roman station which, after the foundation of the bishopric by Boniface in 745, developed considerably and was walled in 908. The bishops of Eichstätt were princes of the Empire, under the archbishops of Mainz, and ruled over large territories in the Circle of Franconia. In 1802 the see was secularized and incorporated in Bavaria. In 1817 it was given, with the duchy of Leuchtenberg, as a mediatized domain under the Bavarian crown, by the king of Bavaria to his son-in-law Eugène de Beauharnais, ex-viceroy of Italy, henceforth styled duke of Leuchtenberg. In 1855 it reverted to the Bavarian crown.

EICHWALD, KARL EDUARD VON (1795–1876), Russian geologist and physician, was born at Mitau, Courland, on July 4, 1795. He became doctor of medicine and professor of zoology in Kazan in 1823; four years later professor of zoology and comparative anatomy at Vilna; in 1838 professor of zoology, mineralogy and medicine at St. Petersburg; and finally professor of palaeontology in the institute of mines in that city. He travelled much in the Russian empire. He died at St. Petersburg on Nov. 10, 1876. His published works include *Reise auf dem Caspischen Meere und in den Caucasus*, 2 vols. (Stuttgart and Tübingen, 1834–1838); *Die Urwelt Russlands* (St. Petersburg, 1840–1845); *Lethaea Rossica, ou paléontologie de la Russie*, 3 vols. (Stuttgart, 1852–1868), with Atlases.

EIDER, a river of north Germany in Schleswig-Holstein. It rises to the south of Kiel, in Lake Redder, flows first northward, nearly as far as Kiel, then bends westward and flows across the low peninsula in a sluggish, winding course of about 117 m. Tönning stands at the head of its long shallow estuary. It is navigable up to Rendsburg, and is embanked through the marshes across which it runs in its lower course. Since the reign of Charlemagne, the Eider (originally *Ägyr Dör*—Neptune's gate) was known as *Romani terminus imperii* and was recognized as the boundary of the Empire in 1027 by the emperor Conrad II., the founder of the Salian dynasty. In the controversy arising out of the Schleswig-Holstein question, which culminated in the war of Austria and Prussia against Denmark in 1864, the Eider gave its name to the "Eider Danes," the *intransigeant* Danish party which maintained that Schleswig (Sönderjylland, South Jutland) was by nature and historical tradition an integral part of Denmark. The Eider canal (*Eider-Kanal*), which was constructed between 1777 and 1784, leaves the Eider at the point where the river turns to the west and enters the Bay of Kiel at Holtenau. It was hampered by six sluices, but was used annually by some 4,000 vessels and until its conversion in 1887–95 into the Kaiser Wilhelm canal afforded the only direct connection between the North sea and the Baltic. (*See* KIEL CANAL.)

EIDER, *Somateria mollissima*, a large marine duck, famous for its down. The common eider nests on low rocky isles near the coast, and in Iceland and Norway has long been afforded every encouragement and protection. Despite its clumsy appearance, the eider flies fast and dives admirably. The male in breeding dress is velvet-black beneath and white above. In the "eclipse" plumage, he resembles the female, which is dark reddish-brown, barred with black. The nest is lined with the down from the mother's breast and contains a variable number of eggs. By removing both down and eggs at intervals of a few days, the owners of the "eider-fold" make the birds deposit both during the whole season, though they are careful to allow every bird to hatch a clutch of eggs ultimately. The eider breeds from the Farne Islands to Spitzbergen. When the female is disturbed at the nest, she trails off in front of the intruder as if wounded. In America the allied *S. dresseri* nests from the coasts of Newfoundland northwards and also in Greenland; north of the Danish settlements there, however, it is replaced by the king-eider (*S. spectabilis*), a very beautiful bird which also nests in Spitzbergen. On the west coast of North America occur *S. v-nigra* and two other eiders, the spectacled eider and steller's eider, the last a bird of the high Arctic and sub-Arctic coasts of the northern hemisphere. The extinct Labrador duck (*S. labradoria*) also belongs to this group.

EIDETIC IMAGES are subjective visual phenomena which assume a perceptual character and which resemble negative or positive after-images in that they are "seen" in the literal sense of the word. An eidetic individual is not only able to *imagine* an absent object but also to *see* it, either when he closes his eyes or looks at some surface which serves as convenient background for his eidetic image. An object may be eidetically seen either immediately after it has been removed from sight or after a considerable period of time (minutes, days, years) has elapsed since the removal; there are also spontaneous eidetic images. As regards form, colour, size, position in space, richness of details and other characteristics, the eidetic image may, in various ways, differ from the object which it represents. The individual who possesses eidetic images *i.e.*, "images of hallucinatory clearness," is in general a "normal and healthy" person; in other words, most hallucinations, pseudo-hallucinations and related phenomena are not to be referred to as eidetic images, although clinically it may be difficult to distinguish between the two. Urbantschitsch's investigations (1907) suggested a pathological basis for eidetic phenomena. O. Kroh (1917) discovered that eidetic images were frequently found in normal children. E. R. Jaensch's experiments brought out the fact that eidetic images are distinctly different from negative after-images and memory-images although their behaviour is in many respects similar. In fact, E. R. Jaensch asserts that eidetic images represent two extremes; they are either pronounced after-images or *visible* memory-images. Jaensch also maintains that most individuals during childhood pass through an eidetic "phase." The frequency of the eidetic disposition, however, varies considerably in different geographic regions. In certain regions 80–100% of the children are reported eidetic. The experimental work as done by the Marburg school has led to the conclusion that the presence of eidetic imagery in an eidetic individual implies the existence of closely correlated "typical" characteristics in his physical make-up in the perceptions, after-images and memory-images of this individual, and in his intellectual and emotional life. Thus the eidetic type is a biotype, *i.e.*, a definite "psychophysical reaction system." W. Jaensch assumes two eidetic [illegible] (referring to tetany) and the B-type (referring to Basedow's syndrome).

Eidetic images exist in many individuals and they can be subjected to laboratory methods. Aside from Germany, experimental work on the eidetic disposition has been done in England (G. W. Allport), France (Quercy), Italy (Kiesow) and in different regions of the United States (Kliiver). Phenomena corresponding to eidetic images in the visual field are supposed to exist in other sense-fields as well. H. Henning maintains that images do not exist at all in the field of the lower senses. Here all past sensory experiences are revived eidetically.

See E. R. Jaensch: *Die Eidetik* (Leipzig, 1925); E. R. Jaensch and others, *Ueber den Aufbau der Wahrnehmungswelt* (Leipzig, 1927); H. Klüver, "Studies on the Eidetic Type and on Eidetic Imagery," *Psychol. Bull.*, No. 25 (1928). (H. Kl.)

EIFEL, a district of Germany, between the Rhine, the Moselle and the frontier of Luxemburg. It is a hilly region, most elevated in the eastern part (Hohe Eifel), where there are several points above 2,000 ft. above sea-level. In the west is the Schneifels; and the southern part, where the most picturesque scenery and chief geological interest is found is called the Vorder Eifel.

The Eifel is an ancient massif of folded Devonian rocks and upon its margins, near Hillesheim and towards Bitburg and Trier, Triassic sandstones, marls and limestones rest unconformably. On the southern border, at Wittlich, terrestrial deposits of the Permian Rothliegende also occur. Lower Devonian slates and sandstones form the greater part of the region; but folded amongst these, in troughs running from south-west to north-east lie the Middle Devonian fossiliferous limestones, and occasionally, *e.g.*, near Büdesheim, small patches of Upper Devonian. Upon these peneplaned Devonian strata stand numerous small volcanic cones of Tertiary age, many of which, though now extinct, are still very perfect in form. Emission of carbon dioxide and heated waters still occurs in many places. The eruptions probably ceased in Quaternary times for the lavas of Papenkaule are clearly posterior to the excavation of the valley of the Kyll, and a lava flow has forced the Uess to seek a new course. The volcanic rocks occur both as tuffs and as lava-flows. They are chiefly leucite and nepheline rocks, such as leucitite, leucitophyre and nephelinite, but basalt and trachyte also occur. The leucite lavas of Niedermendig contain haüyne in abundance. The most extensive and continuous area of volcanic rocks is that surrounding Laacher See and extending eastwards to Neuwied and Coblenz and even beyond the Rhine.

The numerous so-called crater-lakes or *maare* present several features of interest. They do not, as a rule, lie in true craters at the summit of cones, but rather in hollows formed by explosions. The most remarkable group is that of Daun, where the three depressions of Gemünd, Weinfeld and Schalkenmehren have been hollowed out in Lower Devonian strata. The first of these shows no sign of either lavas or scoriae, but volcanic rocks occur on the margins of the other two. The two largest lakes in the Eifel region, however, are Laacher See and Pulvermaar.

EIGHT HOURS DAY: *see* HOURS OF LABOUR.

EILDON HILLS, three conical volcanic hills in Roxburghshire, Scotland, 1 m. S. by E. of Melrose. They were once known as Eldune—the *Eldunum* of Simeon of Durham (*fl* 1130)—probably from the Gaelic *aill*, "rock," and *dun*, "hill"; or a corruption of the Cymric *moeldun*, "bald hill." The northern peak is 1,327 ft. high, the central 1,385 ft. and the southern 1,216 ft. According to General William Roy (1726–1790) the Roman station of *Trimontium*—so called, according to this theory, from the triple Eildon heights—was Old Melrose; other authorities incline to place the station on the northern shore of Solway Firth. The Eildons have been the subject of much legendary lore. The Eildon Tree Stone, a large moss-covered boulder, lying on the high road as it bends towards the west within 2 m. of Melrose, marks the spot where the Fairy Queen led Thomas of Erceldoune into her realms in the heart of the hills.

EILENBURG, a town of Germany, in the Prussian province of Saxony, on an island formed by the Mulde, 31 m. E. from Halle, at the junction of the railways Halle-Cottbus and Leipzig-Eilenburg. Pop. (1925) 18,156. The industries of the town include the manufacture of chemicals, cotton, cigars, celluloid and agricultural implements, etc., and trade in cattle. In the neighbourhood is the iron foundry of Erwinhof. The castle (Ilburg) is mentioned in records of the reigns of Henry the Fowler as an important outpost against the Sorbs and Wends. The town itself, originally called Mildenau, is of great antiquity. It is first mentioned as a town in 981, when it belonged to the house of Wettin and was the chief town of the East Mark. In 1386 it was incorporated in the margraviate of Meissen. In 1815 it passed to Prussia.

EINBECK or **EIMBECK,** a town of Germany, in the Prussian province of Hanover, on the Ilm, 50 m. by rail S. of Hanover. Pop. (1925) 9,683. It is an old-fashioned town with many quaint old wooden houses, notable among them the "Northeimhaus." The industries include brewing, weaving and horsehair-spinning, and the manufacture of cycles, carpets, sugar, chemicals and soap.

Einbeck grew up round the monastery of St. Alexander (founded 1080), famous for its relic of the True Blood. It is first recorded as a town in 1274, and in the 14th century was the seat of the princes of Grubenhagen, a branch of the ducal house of Brunswick. The town later joined the Hanseatic League. In the 15th century it became famous for its beer ("Eimbecker"). In 1540 the Reformation was introduced by Duke Philip of Brunswick-Saltzderhelden (d. 1551), with the death of whose son Philip II. (1596) the Grubenhagen line became extinct.

EINDHOVEN, in the province of North Brabant, Holland, and a railway junction 8 m. W. by S. of Helmond. Pop. (1900) 4,730; (1927) 65,888. Like Tilburg and Helmond it has developed into a flourishing industrial centre, with textile, tobacco and radio factories. It is the centre of the electric bulb industry.

EINHARD (*c.* 770–840), the friend and biographer of Charlemagne. He is also called Einhartus, Ainhardus or Heinhardus, in early manuscripts, and in 10th century mss. Agenardus, Eginhardus, or Eginhartus.

According to the statement of Walafrid Strabo, Einhard was born of a noble family in the Main valley. His birth has been fixed at about 770. He was educated in the monastery of Fulda, where he was certainly residing in 788 and in 791. He was transferred, not later than 796, from Fulda to the palace of Charlemagne by abbot Baugulf, and soon rose in the emperor's service. He was one of the palace scholars, and was entrusted with the charge of the public buildings, receiving the name of Bezaleel (Exodus xxxi. 2 and xxxv. 30–35) owing to his artistic skill. He also supervised the erection of the palace buildings at Aix, and in 806 was sent by Charlemagne on a mission to Rome. When Louis became sole emperor in 814 he retained his father's minister, made him tutor to his son, Lothair, afterwards the emperor Lothair I., and showed him many other marks of favour. Einhard married Emma, or Imma, a sister of Bernharius, bishop of Worms, and a tradition of the 12th century represented this lady as a daughter of Charlemagne, inventing a romantic story for which there is no foundation. In 815 Louis I. bestowed on Einhard and his wife the domains of Michelstadt and Mulinheim in the Odenwald, and in a document of the same year, he is referred to as abbot. After this time he is mentioned as head of several monasteries. In 818 he had given his estate at Michelstadt to the abbey of Lorsch, but he retained Mulinheim, where *c.* 827 he founded an abbey and erected a church, where he deposited some relics of St Peter and St. Marcellinus, which he had procured from Rome. To Mulinheim, afterwards called Seligenstadt, he finally retired in 830. He died on March 14, 840, his epitaph being written by Hrabanus Maurus. Einhard was a man of very short stature, a feature on which Alcuin wrote an epigram. He was on intimate terms with Alcuin, was well versed in Latin literature, and knew some Greek.

His most famous work is his *Vita Karoli Magni,* to which a prologue was added by Walafrid Strabo. Written in imitation of the *De vitis Caesarum* of Suetonius, this is the best contemporary account of the life of Charlemagne, being written by one who was intimate with the emperor and his court. It is an admirably simple and direct narrative; its only fault is that it is too brief. It was written before 821, and was first printed at Cologne in 1521. Other works by Einhard are: *Epistolae,* important for the history of the times: *Historia translationis beatorum Christi martyrum Marcellini et Petri,* which gives a curious account of how the bones of these martyrs were stolen and conveyed to Seligenstadt, and what miracles they wrought; and *De adoranda cruce.* It has been asserted that Einhard was the author of some of the Frankish annals, and especially of part of the annals of Lorsch (*Annales Laurissenses majores*), and part of the annals of Fulda (*Annales Fuldenses*).

Editions of his works are by A. Teulet, *Einhardi omnia quae extant opera* (Paris, 1840–43), with a French translation; P. Jaffé, in the *Bibliotheca rerum Germanicarum,* Band iv. (Berlin, 1867); G. H. Pertz in the *Monumenta Germaniae historica* (Hanover, 1826 *seq.*) and J. P. Migne in the *Patrologia Latina,* tomes 97 and 104 (Paris, 1866). The *De adoranda cruce* was first published by E. Dümmler in the *Neues Archiv der Gesellschaft für ältere deutsche Geschichtskunde* Band xi. (Hanover, 1886). There are Eng. translations of the *Life of Charlemagne* by A. J. Grant in the King's Classics Series (1905) and by H. W. Garrod (1915), of the *Letters* by H. Prebel 1913, and of the *Hist. of the Translation of . . . Marcellinus and Peter* by B. Wendell (1926). *See* A. Potthast, *Bibliotheca historica* (Berlin, 1896), W. Wattenbach, *Deutschlands Geschichtsquellen,* Band i. (Berlin, 1904) and M. Buchner, *Einhards Künstler- und Gelehrtenleben* (Bonn, 1922).

EINHORN, DAVID (1809–1879), leader of the Jewish reform movement in the United States of America, was born in Bavaria. He was a supporter of the principles of Abraham Geiger (*q.v.*), and while still in Germany advocated the introduction of prayers in the vernacular, the exclusion of nationalistic hopes from the synagogue service, and other ritual modifications. In 1855 he migrated to America, where he became the acknowledged leader of reform, and laid the foundation of the régime under which the mass of American Jews (excepting the newly arrived Russians) now worship. In 1858 he published his revised prayer book which has formed the model for all subsequent revisions. In 1861 he strongly supported the anti-slavery party, and was forced to leave Baltimore where he then ministered. He continued his work first in Philadelphia and later in New York. (I. A.)

EINSIEDELN, the most populous town in the Swiss canton of Schwyz, on the right bank of the Alpbach (an affluent of the Sihl). It is 2,908 ft. above sea-level, and 25 m. S.E. of Zürich. It communicates directly with Schwyz over the Hacken pass (4,649 ft.) or the Holzegg pass (4,616 ft.). In 1920 the population was 8,228, all (save 99) Romanists and (save 60) German-speaking. The town is dependent on the Benedictine abbey that rises slightly above it to the east. The abbey was founded about 934, on the site of a hermit's cell. In 1274 the reigning abbot was made a prince of the Holy Roman Empire. Originally under the protection of the counts of Rapperswil (to which town on the lake of Zürich the old pilgrims' way still leads over the Etzel pass, 3,146 ft., with its chapel and inn), this position passed by marriage in 1295 to the Laufenburg Habsburgs, but from 1386 was permanently occupied by Schwyz. Throngs of pilgrims resorted to Einsiedeln in the middle ages. The existing buildings date from the 18th century and the treasury and library contain many precious objects, despite the sack by the French in 1798. Zwingli was the parish priest of Einsiedeln 1516–18, while near the town Paracelsus (1493–1541) was born.

EINSTEIN, ALBERT (1879–), German-Swiss physicist, was born of Jewish parents at Ulm, Württemberg, May 14, 1879. His boyhood was spent at Munich where his father, who owned electro-technical works, had settled. The family migrated to Italy in 1894, whilst Albert Einstein went to a cantonal school at Aarau in Switzerland. He attended lectures while supporting himself by teaching mathematics and physics at the polytechnic school at Zürich until 1900 and finally, after a year as tutor at Schaffhausen, was appointed examiner of patents at the patent office at Berne, where, having become a Swiss citizen, he remained until 1909. It was during this period that he took his Ph.D. degree at the University of Zürich and published his first papers on physical subjects. These were so highly thought of that in 1909 he was appointed extraordinary professor of theoretical physics at the University of Zürich. In 1911 he accepted the chair of physics in Prague, only to be induced to return to his own polytechnic school at Zürich as full professor in the following year. In 1913 his pre-eminence had become so evident that a special position was created for him in Berlin, director of the Kaiser-Wilhelm Physical Institute. He was elected a member of the Royal Prussian Academy of Sciences and given a stipend sufficient to enable him to devote all his time to research without any restrictions or routine duties. He was elected a foreign member of the Royal Society in 1921, having also been made previously a member of the Amsterdam and Copenhagen Academies, while the universities of Geneva, Manchester, Rostock and Princeton conferred honorary degrees on him. In 1925 he

received the Copley Medal of the Royal Society and in 1926 the gold medal of the Royal Astronomical Society in recognition of his theory of relativity. He received a Nobel Prize in 1921.

Einstein's work is so important and has proved fertile in so many various branches of physics that it is not possible to do more than enumerate a few of the most salient papers. The work by which he is best known, the theory of relativity, was begun in 1905 with the publication of the restricted principle with its consequences (*see* RELATIVITY: SPACE-TIME). Though considered fantastic by many, it had secured fairly general acceptance in Germany in 1912. The restricted theory was followed by the generalized theory in 1915. But Einstein's work has been by no means confined to such abstract questions. One of his earliest publications gave the complete theory and formulae of the phenomenon known as Brownian motion, which had puzzled physicists for nearly 80 years. Sooner, probably, than anybody else he realized the far-reaching implications of the theory propounded by Planck, and Einstein spent much of his time on the problems which could be explained by the quantum theory. A series of papers in 1905, 1906, 1909 and 1911 developed his "light-quantum" hypothesis which assumes that radiation when propagated has a "quantum-like" structure. In dealing with the transformation of these light quanta Einstein developed his Law of the Photo-electric effect. His paper on the variation of the specific heat with temperature, which appeared in 1907, was the first extension of Planck's fundamental hypothesis, and its verification in essentials is one of the most convincing arguments in its favour. In 1917 Einstein published a paper in which he deduced the Law of Radiation using the generalized Bohr atom instead of Planck's linear oscillator. Numerous other papers on molecular physics, including an experimental research on magnetism, appeared in the *Proceedings* of the Russian Academy of Science, the *Physikalische Zeitschrift*, the Proceedings of the German Physical Society, the *Annalen der Physik*, and elsewhere. In this *Encyclopædia* he has written the article SPACE-TIME.

In 1929 Einstein published two short papers on what he terms a unified field theory which represents an attempt to find a mathematical expression of formal simplicity to represent comprehensively the laws of gravitation and electro-magnetism.

EINTHOVEN, WILLEM (1860–1927), Dutch physiologist, was born on May 22, 1860, at Samarang, in Java, and was educated at Utrecht under Donders. In 1885 he was made professor of physiology at Leyden, where he remained until his death, on Sept. 29, 1927. In 1924 he was awarded the Nobel prize for physiology and medicine for his discovery of the mechanism of the electro-cardiogram. He was also renowned for his application of the string-galvanometer in the investigation of the mechanism of the electrical phenomena of the human heart.

EISENACH, a town of Germany, in Thuringia; lies at the north-west foot of the Thuringian forest, at the confluence of the Nesse and Hörsel, 32 m. by rail W. from Erfurt. Pop. (1925) 43,869. Interesting buildings include the formal ducal palace built in 1742; the late-Gothic St. Georgenkirche; the Nikolaikirche, built about 1150 and restored in 1887; the Klemda, a small castle dating from 1260; the Lutherhaus, in which the reformer stayed with the Cotta family in 1498; the house in which Sebastian Bach was born, and that (now a museum) in which Fritz Reuter lived (1863–1874). Eisenach has a school of forestry, a school of design, a Gymnasium containing the Thuringian museum and a Wagner museum. The most important industries of the town are worsted-spinning, carriage and wagon building, and the making of colours and pottery. Among others are the manufacture of cigars, cement pipes, iron-ware and machines, alabaster ware, shoes, leather, etc., cabinet-making, brewing, granite quarrying and working.

The natural beauty of the district attracts summer visitors. Magnificently situated on a precipitous hill, 600 ft. above the town to the south, is the historic Wartburg (*q.v.*), the ancient castle of the landgraves of Thuringia, famous as the scene of the contest of Minnesingers immortalized in Wagner's Tannhäuser, and as the place where Luther, on his return from the diet of Worms in 1521, was kept in hiding and made his translation of the Bible.

Eisenach (*Isenacum*) was founded in 1070 by Louis II. the Springer, landgrave of Thuringia. The Klemda, mentioned above, was built by Sophia (d. 1284), daughter of the landgrave Louis IV., and wife of Duke Henry II. of Brabant, to defend the town against Henry III., margrave of Meissen, during the succession contest that followed the extinction of the male line of the Thuringian landgraves in 1247. The principality of Eisenach fell to the Saxon house of Wettin in 1440, and in the partition of 1485 formed part of the territories given to the Ernestine line. It was a separate Saxon duchy from 1596 to 1638, from 1640 to 1644, and again from 1662 to 1741, when it finally fell to Saxe-Weimar. The town of Eisenach, by reason of its associations, has been a favourite centre for religious propaganda.

EISENBERG (*Isenberg*), a town of Germany, in the republic of Thuringia on a plateau between the rivers Saale and Elster, 20 m. S.W. from Zeitz. Pop. (1925) 11,304. It possesses an old castle and several churches. Its principal industries are metal working and the manufacture of machines, photographic plates, toys, ovens, furniture, pianos, porcelain and sausages.

EISENERZ, an old mining town in Styria, Austria. It lies in a deep valley, tributary to that of the Enns and is dominated by imposing peaks, one of which, the Erzberg (5,030 ft.), to the south is connected with the town by a rack railway which descends to Vordernberg on the south side of the Erzberg. On this mountain is quarried in the summer months the rich iron ore to which the town owes its prosperity. Nearly one million tons of ore, with a 35 per cent iron content, are raised annually, part of this output being handled in the iron and steel foundries of Vordernberg and Eisenerz. The Gothic church of St. Oswald, founded in the 13th century and rebuilt in the 16th, is an interesting example of a mediaeval fortified church. Pop. (1920) 8,600.

EISENSTEIN, FERDINAND GOTTHOLD (1823–1852), German mathematician, was born in Berlin on April 16, 1823. He was educated at Berlin university, where he became *privatdozent*, subsequently professor of mathematics. He was the author of a number of papers published in *Crelle's Journal* on the theory of numbers and elliptic functions (*q.v.*). In his memoir, *Neue Theoreme der höheren Arithmetik* Eisenstein developed the theory of complex numbers (*q.v.*). He extended the work of Gauss in ternary quadratic forms from two to three indeterminates. He only dealt with cases of an uneven determinant; his results were extended later by Henry Smith to cases of an even determinant. Eisenstein dealt with the theory of binary quadratic forms and discovered the first covariant used in analysis. He discussed doubly infinite products using analytical methods, this was used later by Weierstrass in representing some of his functions. In his work on the representation of numbers by sums of squares, Eisenstein showed that the general theorem was limited to eight squares; he gave the solutions for three and five squares; this work was extended later by Henry Smith.

Eisenstein was a member of the Berlin academy. He died in Berlin on Oct. 11, 1852.

EISLEBEN, a town of Germany, in the Prussian province of Saxony, 24 m. W. by N. from Halle. Pop. (1925) 23,758. The earliest record of Eisleben (Lat. *Islebia*) is dated 974. In 1045, at which time it belonged to the counts of Mansfield, it received the right to hold markets, coin money, and levy tolls. In the 18th century Eisleben fell to Saxony, and, in the partition of Saxony by the congress of Vienna in 1815, was assigned to Prussia. It is divided into an old and a new town (Alstadt and Neustadt). The church of St. Peter and St. Paul (Peter-Paulkirche), contains the font in which Luther was baptized; the royal gymnasium (classical school), was founded by Luther shortly before his death in 1546. The house in which Luther was born was burned in 1689, but was rebuilt in 1693 as a free school for orphans. This school fell into decay, but was restored in 1817 by King Frederick William III. of Prussia, who, in 1819, transferred it to a new building behind the old house. The house in which Luther died was restored towards the end of the 19th century, and his death chamber is still preserved. In the neighbour-

wood potash is obtained and manufactures include machinery, furniture and cigars. It is also a centre for plant breeding.

EISLER, RUDOLF (1873–), German philosopher, was born on Jan. 7, 1873, at Vienna, and was educated at Leipzig, where he continued to reside. The influence of Kant and the 19th century idealistic thinkers, and the spiritualistic dynamism of his metaphysics colour his works, the chief of which are: *De Weiterbildung der Kantschen Aprioritätslehre* (1895); *Grundlagen der Phil. des Geisteslebens* (1908); *Geschichte des Monismus* (1910); *Geist und Körper* (1912; 2nd ed., 1925); *Der Zweck* (1924). Eisler has also translated various philosophical works and compiled *Wörterbuch der philos. Begriffe* (1899; 4th ed., 1927); *Philosophen-lexicon* (1912) and *Handwörterbuch der Philosophie* (1913; 2nd ed., 1922).

EISNER, KURT (1867–1919), Bavarian politician and writer, was born in Berlin on May 14, 1867. He became a journalist, and was frequently imprisoned because of the socialist tendency of his writings. He was successively on the editorial staff of *Vorwärts* in Berlin (1898–1905) and of socialist newspapers at Nuremberg and Munich. After the outbreak of the World War he turned against his old allies, the Social Democrats, and attacked them for supporting the war. Convicted of treason in Jan. 1918, he was released on account of his candidature for the Reichstag, and was in time to organize the mass meeting which was held at Munich on Nov. 7, 1918, and resulted in the overthrow of the Bavarian monarchy. A Bavarian revolutionary and socialist government, with Eisner as its president, was established. He was opposed to the re-establishment of the federal system of the German Reich and to the election of a National Constituent Assembly. His revelations regarding Germany's responsibility for the War increased his unpopularity with the Bavarian reactionaries; and on his way to open the Bavarian assembly on Feb. 21, 1919, he was shot dead in the street by Count Arco-Vally. Among Eisner's various written works are *Psychopathia Spiritualis* (1892); *Eine Junkerrevolte* (1899); *Wilhelm Liebknecht* (1900); *Feste der Festlosen* (1903); and *Die Neue Zeit* (1919). His works were published in collected form in 1919.

EISTEDDFOD (is-tĕ*th*'vŏd), (plural Eisteddfodau), the national bardic congress of Wales, which seeks to encourage bardism and music and the general literature of the Welsh, to maintain the Welsh language and customs of the country, and to foster and cultivate a patriotic spirit amongst the people. This institution, so peculiar to Wales, is of very ancient origin, the *Gorsedd* or assembly, an essential part of the modern Eisteddfod, being as old at least as the time of Prydain the son of Aedd the Great, who lived many centuries before the Christian era. The term *Eisteddfod*, however, which means "a session" or "sitting," was probably not applied to bardic congresses before the 12th century.

The Eisteddfod in its present character appears to have originated in the time of Owain ap Maxen Wledig, who at the close of the 4th century was elected to the chief sovereignty of the Britons on the departure of the Romans. It was at this time, or soon afterwards, that the laws and usages of the Gorsedd were codified and remodelled, and its motto of "Y gwir yn erbyn y byd" (The truth against the world) given to it. "Chairs" (with which the Eisteddfod as a national institution is now inseparably connected) were also established, or rather, perhaps, resuscitated, about the same time. The chair was a kind of convention where disciples were trained, and bardic matters discussed preparatory to the great Gorsedd, each chair having a distinctive motto.

The first Eisteddfod of which any account seems to have descended to us was one held on the banks of the Conway in the 6th century, under the auspices of Maelgwn Gwynedd, prince of North Wales. Maelgwn, on this occasion, in order to prove the superiority of vocal song over instrumental music, is recorded to have offered a reward to such bards and minstrels as should swim over the Conway.

Griffith ap Cynan, prince of North Wales, who had been born in Ireland, brought with him from that country many Irish musicians, who greatly improved the music of Wales. During his long reign of 56 years he offered great encouragement to bards harpers and minstrels and framed a code of laws for their better regulation. He held an Eisteddfod about the beginning of the 12th century at Caerwys in Flintshire, "to which there repaired all the musicians of Wales, and some also from England and Scotland." For many years afterwards the Eisteddfod appears to have been held triennially, and to have enforced the rigid observance of the enactments of Griffith ap Cynan. The places at which it was generally held were Aberffraw, formerly the royal seat of the princes of North Wales; Dynevor, the royal castle of the princes of South Wales; and Mathrafal, the royal palace of the princes of Powys; and in later times Caerwys in Flintshire received that honourable distinction, it having been the princely residence of Llewelyn the Last.

On the annexation of Wales to England, Edward I. deemed it politic to sanction the bardic Eisteddfod by his famous statute of Rhuddlan, and the meetings continued to be held, in many cases by royal mandate, till towards the end of the 17th century, after which for a considerable period—some 130 years—they fell into abeyance. At the close of the Napoleonic wars, however, there was a general revival of Welsh national feeling bringing about their resumption and they have been held annually, almost without intermission, ever since.

To constitute a provincial Eisteddfod it is necessary that it should be proclaimed by a graduated bard of a Gorsedd a year and a day before it takes place. A local one may be held without such a proclamation. A provincial Eisteddfod generally lasts three, sometimes four, days. A president and a conductor are appointed for each day. The proceedings commence with a Gorsedd meeting opened with sound of trumpet and other ceremonies, at which candidates come forward and receive bardic degrees after satisfying the presiding bard as to their fitness. At the subsequent meetings the president gives a brief address; the bards follow with poetical addresses, adjudications are made, and prizes and medals with suitable devices are given to the successful competitors for poetical, musical and prose compositions, for the best choral and solo singing, and singing with the harp or "Pennillion singing" as it is called, for the best playing on the harp or stringed or wind instruments, as well as occasionally for the best specimens of handicraft and art. In the evening of each day a concert is given, generally attended by very large numbers. The great day of the Eisteddfod is the "chair" day—usually the third or last day—the grand event of the Eisteddfod being the adjudication on the chair subject, and the chairing and investiture of the fortunate winner. This is the highest object of a Welsh bard's ambition. The ceremony is an imposing one, and is performed with sound of trumpet. (*See* also the articles BARD; CELT: *Celtic Literature;* and WALES.) (R. W.; X.)

EITNER, ROBERT (1832–1905), German composer and music historian, was born at Breslau on Oct. 22, 1832. He published a number of musical compositions, notably *Cantata pour la Pentecôte, Judith*, an opera, *Stabat Mater* and *Ouvorture du Cid*. In 1863 he established a music school in Berlin. It is as an historian of music, however, that he is best known, and among his important publications were *Verzeichnis Neuer Ausgaben alter Musikwerke* (1871); *Bibliographie der Musiksammelwerke des 16. und 17. Jahrhunderts* (1877); and *Biographisch-bibliographisches Quellenlexikon der Musiker und Musikgelehrten bis zur Mitte des 19 Jahrhundert* (10 vol., 1900–04). He died in Templin on Feb. 2, 1905.

EITZ, CARL A. (1848–1924), German teacher of music, was born at Wehrstedt on June 25, 1848. He is the inventor of a system of teaching elementary singing by syllabic notation, which he has named the *Tonwortmethode*. Opinion is divided as to the value of this method, but it has been put into practice by Eitz's adherents in Bavaria and in Prussia (1922) and is finding many new supporters. The principles of the system are set forth in *Bausteine zum Schulgesangunterricht im Sinne der Tonwortmethode* (Leipzig, 1911) and in *Teaching of Singing as Foundation of Musical Education* (Leipzig, 1914). He died at Eisleben on Apr. 18, 1924.

See G. Borchers, *C. Eitz* (Würzburg, 1908); O. Messmer, *C. Eitz, Tonwortmethode* (Würzburg, 1911); F. Bennedik, *Historical, Psychological and Musical Investigations in relation to the Eitz-Tonwort Method* 1914)

EJECT, a term introduced by Clifford (*in Seeing and Thinking*) and adopted by Romanes and others, for the conception that another self is in the first instance apprehended in terms of one's own self, which is ejected as it were, into another body (Latin *ejectum*, something thrown out). The conception has also been employed in connection with animism and anthropomorphism.

EJECTMENT, in law, an action for the recovery of the possession of land, together with damages for the wrongful withholding thereof. In the old English classifications of actions, as real or personal, this was known as a *mixed* action, because its object was twofold, viz., to recover both the realty and personal damages. It should be noted that the term "ejectment" applies in law to distinct classes of proceedings—ejectments as between rival claimants to land, and ejectments as between those who hold, or have held, the relation of landlord and tenant. Real and mixed actions were abolished in 1833. The action of ejectment has now been assimilated (under the name of action for the recovery of land) to ordinary actions by the rules of the supreme court, but is subject to one special rule, viz. that except by leave of the court or a judge the only claims which may be joined with one for recovery of land are claims in respect of arrears of rent or double value for holding over, or mesne profits (*i.e.*, the value of the land during the period of the illegal possession), or damages for breach of a contract under which the premises are held or for any wrong or injury to the premises claimed (R.S.C., O. xviii. r. 2).

Where an action to recover land is brought against the tenant by a person claiming adversely to the landlord, the tenant is bound, under penalty of forfeiting the value of three years' improved or rack rent of the premises, to give notice to the landlord in order that he may appear and defend his title (Law of Property Act, 1925, s. 145). A landlord can recover possession in the county court (i.) by an action for the recovery of possession, where neither the value of the premises nor the rent exceeds £100 a year, and the tenant is holding over (County Courts Acts of 1888, s. 138, and 1903, s. 3); (ii.) by "an action of ejectment," where (*a*) the value or rent of the premises does not exceed £100, (*b*) half a year's rent is in arrear, and (*c*) no sufficient distress (*see* RENT) is to be found on the premises. Where a tenant at a rent not exceeding £20 a year of premises at will, or for a term not exceeding seven years, refuses or neglects, on the determination or expiration of his interest, to deliver up possession, such possession may be recovered by proceedings before justices under the Small Tenements Recovery Act, 1838. (*See* also the Housing Act, 1925, s. 13, and article HOUSING.) Under the Distress for Rent Act, 1737, and the Deserted Tenements Act, 1817, a landlord could have himself put by the order of two justices into premises deserted by the tenant where half a year's rent was owing and no sufficient distress could be found. The Courts (Emergency Powers) Acts, 1914–16, imposed temporary restriction on the recovery of premises during the World War. Under the Increase of Rent and Mortgage Interest (Restriction) Acts, 1920–25, landlords of dwelling houses to which those acts applied were prevented during their continuance from effectually raising the rents of such dwelling houses above specified limits, and except in certain cases from recovering possession thereof on the termination of the tenancy. (*See* LANDLORD AND TENANT; RENT.)

An insured person in receipt of sickness benefit may be protected against proceedings in ejectment on the certificate of the medical practitioner attending him that the taking of such proceedings would endanger his life. Every such certificate continues in force for a week but may be renewed for similar periods up to, but not beyond, the expiration of three months; but proper security for payment of rent must be found, if demanded, within a month. (National Health Insurance Act, 1924, s. 102.)

In *Ireland*, the practice with regard to the recovery of land resembled that of England. Possession might be recovered summarily by a special endorsement of the writ, as in England; and there were analogous provisions with regard to the recovery of small tenements (*see* Land Act, 1860, ss. 84 and 89). The law with regard to the ejectment or eviction of tenants was consolidated by the Land Act, 1860. (*See* ss. 52–66, 68–71, and further under IRELAND; LANDLORD AND TENANT.)

In *Scotland*, the recovery of land is effected by an action of "removing" or summary ejection. In the case of a tenant, "warning" is necessary unless he is bound by his lease to remove without warning. In the case of possessors without title, or a title merely precarious, no warning is needed. A summary process of removing from small holdings is provided for by the Sheriff Courts (Scotland) Act, 1907, s. 38, and as to actions of removing within the ordinary jurisdiction of the sheriff's court *see* ss. 34, 37.

In *French law* the landlord's claim for rent is fairly secured by the hypothec, and by summary powers which exist for the seizure of the effects of defaulting tenants. Eviction or annulment of a lease can only be obtained through the judicial tribunals. The Civil Code deals with the position of a tenant in case of the sale of the property leased. If the lease is by authentic act (*acte authentique*) or has an ascertained date, the purchaser cannot evict the tenant unless a right to do so was reserved on the lease (art. 1743), and then only on payment of an indemnity (arts. 1744–47). If the lease is not by authentic act, or has not an ascertained date, the purchaser is not liable for indemnity (art. 1750). The tenant of rural lands is bound to give the landlord notice of acts of usurpation (art. 1768). There are analogous provisions in the Civil Codes of Belgium (arts. 1743 *et seq.*) and Holland (arts. 1613, 1614), and see the German Civil Code (arts. 535 *et seq.*). In many of the colonies there are statutory provisions for the recovery of land or premises on the lines of English law. (Cf. Ontario, Rev. Stats. 1897, *c.* 170, ss. 19 *et seq.*; Manitoba, Rev. Stats. 1902, *c.* 1903).

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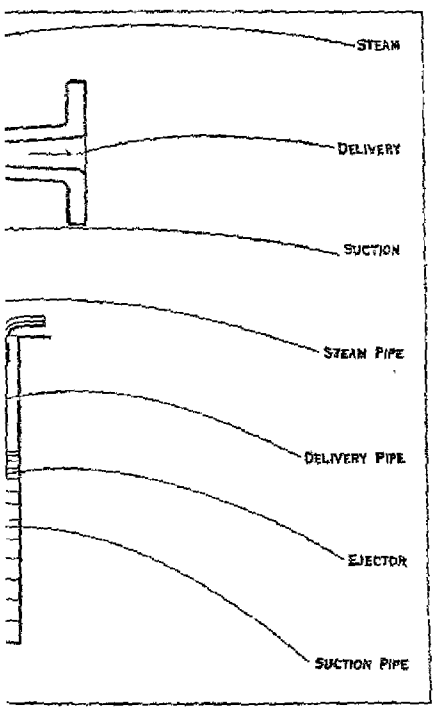
In the *United States* the action of ejectment retains its essential common law character, namely that the action is a possessory one for the recovery of corporeal hereditaments. The procedure for maintaining the action has largely been modified by statute, the fictitious proceedings of the common law being generally abolished. The purpose of the action is to determine the legal right to possession, a determination of which may or may not involve the question of legal title. The plaintiff may also in the action of ejectment recover damages for the wrongful use and occupation of the property. Ejectment lies only for property interests of which possession can be given, that is, corporeal hereditaments. It will not, therefore, lie for an easement or a right of way. A lessee may maintain ejectment to recover possession of a term of years. The general principle governing maintenance of the action is that the plaintiff may recover only upon the strength of his title and not upon the weakness of his adversary's. Ordinarily the plaintiff's right of entry must be based upon a legal claim but many States have extended the scope of the action to permit recovery upon an equitable title as against the holder of a bare legal title where the equitable title is coupled with a right to possession. (J. M. LA.)

EJECTOR. An apparatus which moves air, liquids, and loose materials such as sand, cinders, gravel, liquid clay and chemicals, by the eductive force of steam or compressed air. Inlets are arranged for the steam and the suction, and the former rushing along at high speed draws the air or other element with it. A simple form of ejector and its mode of piping to force water out of a pit or tank are shown in the figure. The draining of wells, foundations, quarries, and the emptying of ships' bilges and ballast tanks lie within the scope of an ejector.

The vacuum brake is operated with the help of an ejector on the engine, steam being admitted around the cones and passing through the ejector barrel at great velocity; this action withdraws the air from the train-pipe and cylinders. This type really combines two ejectors in the body, a small one that works continually to maintain the vacuum, and a large one for rapid production of the vacuum. Another type, for securing economy in

t grea l ar ed working ond ors o
ha wo ma eje or one or bo n
acuum up he a ge e_ec.or .t.l eeing
-g
, are those in which compressed air is
f a liquid, as in the Shone apparatus
ir-ejector employed in connection with



E) AN EJECTOR FOR LIFTING OR FORCING
AND (BELOW) AN EJECTOR ARRANGED FOR
IT
on of the steam rushing along at high velocity.
he train pipe is cleared of air by an ejector on
o

type of condenser used in conjunction
ejector condenser. Sometimes water is
ıe eductive action of a high-pressure jet
:tors include those in revolvers and guns
ge-case, and devices which push punched
ıf the dies in power-presses, when they
vity. Air-ejection is adopted in some
ıd air blowing the work into a chute, and
rt and scale. (*See* also INJECTOR.)

: *see* SVERDLOVSK.

: *see* KRASNODAR.

': *see* DNEPRO-PETROVSK.

(1720–1778). German actor, was born
1720. In 1739 he became a member of
nann's (1704–1782) company in Lüne-
apearance there on Jan. 15, 1740 as
thridate. From 1751 the Schönemann
ly in Hamburg and at Schwerin, where
of Mecklenburg-Schwerin made them
During this period Ekhof founded a
1757 Ekhof left Schönemann to join
at Danzig; but he soon returned to
wo other actors, he succeeded Schöne-
the company. He resigned in favour of
e acted until 1764, when he joined K. E.
ı 1767 was founded the National theatre
us by Lessing's *Hamburgische Drama-*
leading member of the company. Ekhof
tor of the new court theatre at Gotha,
tablished theatre in Germany. Goethe
rman tragic actor; and in 1777 he acted
ıarles Augustus at a private performance
June 16, 1778. He was regarded by his
con emporar s ar ar urp s ed exponent of n.. ıralness on .he
s age and he ha_ bee.. no. unfairly compared with Garrick. His
fame, however, was rapidly eclipsed by that of Friedrich U. L
Schröder.

See H. Uhde, biography of Ekhof in vol. iv. of *Der neue Plutarch* (1875); J. Kürschner, *K. Ekhofs Leben und Wirken* (1872); H Devrient, *J. F Schönemann und seine Schauspielergesellschaft* (1895), Landau, *Mimen* (1912)

EKKPÉ or **EGBO,** a secret society flourishing in southern Nigeria and the Calabar district, West Africa. Ekkpé (leopard in Ibibio) is a dual spirit, male and female, and only males can join, boys being initiated about the age of puberty. Members are bound to secrecy and heavy entrance fees are payable. The Egbo-men are ranked in seven or nine grades, for promotion to each of which fresh initiation ceremonies, fees and oaths are necessary. The society combines a cult, a freemasonry with political and law-enforcing aims. The society was used to recover debts from an outsider and to maintain the authority of the free-born over slaves. The cult turns on ancestor worship and includes fertility rites. There are esoteric secrets known only to the highest grade of initiate. The Egbo-house, an oblong building, usually stands in the middle of the villages. The walls are of clay elaborately painted inside and ornamented with clay figures in relief. Inside are wooden images, sometimes of an obscene nature, to which reverence is paid. At certain festivals in the year the Egbo-men wear black wooden masks with horns which it is death for any woman to look on.

See Mary H. Kingsley, *West African Studies* (1901); P. A. Talbot, *The Peoples of Southern Nigeria* (1926).

EKRON, an ancient city of Palestine (mod. 'Ākir); pop. 1,200; 5 m. from Ramleh, on the Jaffa-Jerusalem railway. Although included by the Israelites in the territory of Judah and mentioned in Joshua xix. as a city of Dan, it was occupied by the Philistines in the days of Samuel, and was the nearest of the Pentapolis to Israelite territory. The sanctuary of Baal-Zebub was here, and the restoration of the ark to Israel was by the road up the Vale of Sorek to Beth-Shemesh, 12 m. away. According to Assyrian records, its king was forced by his subjects to side with Hezekiah, but regained his independence with the advance of Sinaherib. The town was ceded to the Maccabees (147 B.C); and after the destruction of Jerusalem (A.D. 70) many Jews established themselves here. The neighbourhood is fertile, and in 1884 Baron Rothschild settled there a Jewish colony. (E. Ro.)

ELABUGA, a town in the Tatar A.S.S R., on the Kama river, 201 m. by steamboat down the Volga from Kazan and then up the Kama, in lat. 55° 50′ N., long. 52° 6′ E. It has flour-mills, and carries on a brisk trade in exporting corn and is supplied with electricity. Pop. (1926) 11,162

The famous *Ananiynskiy Mogilnik* (burial-place) is on the right bank of the Kama, 3 m. above the town. It was discovered in 1858, was excavated by Alabin, Lerch and Nevostruyev, and has since supplied extremely valuable collections belonging to the Stone, Bronze and Iron Ages. It consisted of a mound, about 500 ft. in circumference, adorned with decorated stones (which have disappeared), and contained an inner wall, 65 ft. in circumference, made of uncemented stone flags. Nearly fifty skeletons were discovered, mostly lying upon charred logs, surrounded with cinerary urns filled with partially burned bones. Bronze decorations and glazed clay pearls were strewn round the skeletons. The knives, daggers and arrowpoints are of slate, bronze and iron, the last two being very rough imitations of stone implements. One of the flags bore the image of a man, without moustaches or beard, dressed in a costume and helmet recalling those of the Circassians.

ELAM, the name given in the Bible to the province of Persia called Susiane by the classical geographers, from Susa or Shushan its capital. Strabo (xv. 3, 12, etc.) makes Susiane a part of Persia proper, but a comparison of his account with those of Ptolemy (vi. 3, 1, etc.) and other writers would limit it to the mountainous district to the east of Babylonia, lying between the Oroatis and the Tigris. Along with this mountainous district went a fertile low tract of country on the western side, which included the marshes

at the mouths of the Euphrates and Tigris. This low tract, producing large quantities of grain, was intensely hot in summer; the high regions however, were cool and well watered.

The whole country was occupied by a variety of tribes, speaking agglutinative dialects for the most part, though the western districts were occupied by Semites. Immediately bordering on the Persians were the Amardians or Mardians, as well as the people of *Khapirti* (*Khatamti*, according to Scheil), the name given to Susiane in the Neo-Susian texts. Khapiru appears as Apir in the inscriptions of Mal-Amir, which fix the locality of the district. Passing over the Messabatae, who inhabited a valley which may perhaps be the modern Mâb-Sabadan, we come to the fourth principal tribe of Susiane, the Cissii (Aesch. *Pers.* 16), or Cossaei, the Kassi of the cuneiform inscriptions (*see* KASSITES). So important were they, that the whole of Susiane was sometimes called Cissia after them, as by Herodotus (iii. 91, v. 49, etc.). In fact Susiane was only a late name for the country, dating from the time when Susa had been made a capital of the Persian empire. In the Sumerian texts of Babylonia it was called Numma, "the Highlands," of which Elamtu or Elamu, "Elam," was the Semitic translation. Apart from Susa, the most important part of the country was Anzan (Anshan, contracted Assan), where the native population lived unaffected by Semitic intrusion.

The principal mountains of Elam were on the north, belonging to the Parachoathras chain. There were numerous rivers flowing into either the Tigris or the Persian Gulf. The most important were the Ulai or Eulaeus (*Kûran*) with its tributary the Pasitigris, the Choaspes (*Kerkhah*), the Coprates (river of *Diz*, called the Ititê in the inscriptions), the Hedyphon or Hedypnus (*Jerrâhi*), and the Croatis (*Hindyan*). Shushan or Susa, the capital now marked by the mounds of *Shush*, stood near the junction of the Choaspes and Eulaeus (*see* SUSA). J. de Morgan's excavations at Susa have thrown a flood of light on the early history of Elam and its relations to Babylon. The earliest settlement there goes back to neolithic times, but it was already a fortified city when Elam was conquered by Sargon of Akkad (3800 B.C.) and Susa became the seat of a Babylonian viceroy. From this time onward for many centuries it continued under Semitic suzerainty. Before the rise of the 1st Dynasty of Babylon, however, Elam had recovered its independence, and in 2280 B.C. the Elamite king Kutur-Nakhkhunte made a raid in Babylonia and carried away from Erech the image of the goddess Nanâ. The monuments of many of his successors have been discovered and their inscriptions deciphered. One of them was the Chedor-laomer (Kutur-Lagamar) of Genesis xiv. About 1330 B.C., Khurba-tila was captured by Kuri-galzu III., the Kassite king of Babylonia, but Sutruk-Nakhkhunte (1220 B.C.) carried fire and sword through Babylonia, slew its king, Zamama-sum-iddin, and carried away a stela of Naram-Sin and the famous code of laws of Khammurabi from Sippara. He also conquered the land of Asnunnak. He was succeeded by his son, who was followed on the throne by his brother, one of the great builders of Elam. In 720 B.C. Khumbanigas met the Assyrians under Sargon at Dur-ili in Yamutbal, and though Sargon claims a victory the result was that Babylonia recovered its independence under Merodach-baladan and the Assyrian forces were driven north. From this time forward it was against Assyria instead of Babylonia that Elam found itself compelled to exert its strength, and Elamite policy was directed towards fomenting revolt in Babylonia and assisting the Babylonians in their struggle with Assyria. In 704 B.C. the combined forces of Elam and Babylonia were overthrown at Kis, and in the following year the Kassites were reduced to subjection. The Elamite king was dethroned and imprisoned in 700 B.C. by his brother Khallusu, who six years later marched into Babylonia, captured the son of Sennacherib, and raised a nominee of his own, Nergal-yusezib, to the throne. In 689 B.C. Khumba-Khaldas II. endeavoured to gain Assyrian favour by putting to death the son of Merodach-baladan, but was himself murdered by his brothers, Urtaki and Teumman (681 B.C.), the first of whom seized the crown. On his death Teumman succeeded and immediately provoked a quarrel with Assur-banipal by demanding the surrender of his nephews who had taken refuge at the Assyrian court. The Assyrians pursued the Elamite army to Susa, where the Elamites were defeated Teumman captured and slain, and Umman-igas, the son of Urtaki made king, his younger brother Tammaritu being given the district of Khidalu. Umman-igas afterwards assisted in the revolt of Babylonia, but his nephew, a second Tammaritu, raised a rebellion against him and seized the crown. Tammaritu marched to Babylonia; while there, his officer Indabigas made himself master of Susa but was himself overthrown and slain by a new pretender Khumba-Khaldas III., who was opposed by three other rivals, two of whom maintained themselves in the mountains until the Assyrian conquest of the country. The return of Khumba-Khaldas led to a fresh Assyrian invasion, and the Elamite army was almost exterminated on the banks of the Ititê. The whole country was reduced to a desert, Susa was plundered and razed to the ground, the royal sepulchres were desecrated, and the images of the gods and of 32 kings "in silver, gold, bronze and alabaster," were carried away. All this must have happened about 640 B.C. After the fall of the Assyrian empire Elam was occupied by the Persian Teispes, the forefather of Cyrus, who, like his immediate successors, is called in the inscriptions "king of Anzan." Susa once more became a capital, and on the establishment of the Persian empire remained one of the three seats of government, its language, the Neo-Susian, ranking with the Persian of Persepolis and the Semitic of Babylon as an official tongue. In the reign of Darius the Susianians attempted to revolt, but they gradually became completely Aryanized, and their agglutinative dialects were supplanted by the Aryan Persian from the south-east.

Elam, "the land of the cedar-forest," with its enchanted trees, figured largely in Babylonian mythology, and one of the adventures of the hero Gilgamesh was the destruction of the tyrant Khumbaba who dwelt in the midst of it. A list of the Elamite deities is given by Assur-bani-pal; at the head of them was In-Susinak, "the lord of the Susians," whose image and oracle were hidden from the eyes of the profane

See *Cambridge Ancient History*, vol. iii. (with useful bibliography); A. Billerbeck, *Susa* (1893), J. de Morgan, *Mémoires de la Délégation en Perse* (1899–1906).

ELAND, the largest of the South African antelopes (*Taurotragus oryx*), the bull reaching a height of as much as 6ft. at the shoulder, and a length of over 9ft.; a species akin to the kudu, but with horns present in both sexes, and their spiral much closer. There is a large dewlap, while old bulls have a thick forelock. In the southern form the body is wholly pale fawn, but north of the Orange river the body is marked by narrow vertical white lines. In Senegambia the genus is represented by *T. derbianus*, a larger animal, with a dark neck; while in the Bahr-el-Ghazal district there is a gigantic local race of this species.

ELANDSLAAGTE, ACTION OF (Oct. 21, 1899). *see* SOUTH AFRICAN WAR.

ELASMOBRANCH: *see* SELACHIANS.

ELASTICITY. The word *elastic*, derived originally from the Greek verb ἐλαύνειν to drive, has acquired its present meaning largely from the writings of Robert Boyle. In 1660, in a description of his experiments relating to the spring of the air he says, "There is a spring or elastical power in the air in which we live." This spring he attributed to an effort made by each particle of air to drive its neighbours away. For the sake of illustration, a particle of air was at that time pictured with little springs attached to it, these springs being compressed by those of neighbouring particles.

The chief characteristic of a spring is its power of recovering a former durable shape and size when the load causing a temporary deformation is removed. The spring possesses this power whether it is stretched or compressed. A similar power of recovery, when deforming forces are removed, is possessed to some extent by any solid body. This power is described in a general way by saying that the body is elastic. If recovery is prevented by some other body or bodies, the effort which the body makes to recover its original durable form may be represented by an elastic force or system of elastic forces. This application of the word elastic to the forces exerted by deformed solid bodies was made by Boyle. In an essay on effects of motion written in 1685 he says "By

the elastical force of the bent bow the string is brought into a moment state of tension.

LAWS OF ELASTICITY

Boyle's Law.—The first law of elasticity was published in 1662 by Boyle, and in 1676 by Edmé Mariotte. It is now called the law of the isothermal expansion or contraction of a "perfect" gas and is generally written in the form

$$pv=f(\theta),$$

where v is the volume of unit mass of the gas and p the pressure intensity (*see* HYDROMECHANICS). The quantity on the right-hand side depends only on the temperature θ, which was kept constant in Boyle's experiments. When θ is the *absolute* temperature, as measured by an air-thermometer, $f(\theta)$ becomes simply $R\theta$, where R is a constant depending on the nature of the gas. The quantity v is the reciprocal of the density (ρ), and is frequently called the *specific volume*, while p is called simply the *pressure*. The law indicates that, under isothermal conditions, the pressure is proportional to the density. For a real gas this law has only a limited validity, it fails at high pressures and low temperatures, *i.e.*, under conditions close to those at which liquefaction occurs.

If dp and dv denote small changes in p and v at constant temperature, Boyle's law gives the equation

$$p=-v\frac{dp}{dv}\quad(=k).$$

The quantity on the right is called the *volume-elasticity*; under isothermal conditions it is equal to the pressure, but under adiabatic conditions, *i.e.*, when there is neither gain nor loss of heat it is equal to γp where γ, the ratio of the specific heats at constant pressure and constant volume, is always greater than 1 and is about 1·4 for air.

In Boyle's law the pressure is supposed to be constant throughout the unit mass of gas, but, since the choice of this unit is arbitrary, the law may be applied to a small portion of the gas, whose size may be diminished indefinitely. The limiting value of the ratio dv/v is called the *dilatation* (Δ), and $-\Delta$ is called the *compression*. The volume-elasticity k is thus the ratio of the increase of pressure to the resulting compression. With a suitable definition of pressure this law is also applicable to solids, and to prevent misunderstanding the pressure so defined is often called *hydrostatic pressure*.

Hooke's Law.—The first law of elasticity for solid bodies was discovered by Robert Hooke in 1660, and published in 1676 in the form of an anagram meant to represent the words *Ut tensio sic vis*. *Tensio* is understood to mean what is now called *extension*. Thus, in the case of a wire stretched to a new length L, is the ratio of the gain in length, $L-l$, to the original length l. Interpreting *vis* as the tension in the wire, the law states that the tension is proportional to the extension. If the tension is regarded as a force, the factor of proportionality is found, not to be a physical constant for the substance of which the wire is made, but to depend upon the area of the cross-section of the wire as well as upon the properties of the substance. For this reason it is more convenient to regard tension as a *stress*, *i.e.*, the ratio of a force to the area across which it is transmitted. A more general and precise definition of stress, due to Augustin Louis Cauchy, will be given later, but the present one will suffice to indicate the physical dimensions of a stress and the most convenient units of stress. Extension will be regarded as a particular type of *strain*, a physical quantity which is always the ratio of two lengths and therefore a mere number, so no unit of strain is needed.

Hooke's law may be expressed in the form of an equation

$$S=Es,$$

where S is the stress, s the strain and E a modulus of elasticity, now called *Young's modulus*, in honour of Thomas Young, who gave it a physical meaning. This law does not hold for very great values of S, and even with small values of S it does not give a complete description of the elastic behaviour of the substance as there is a lateral contraction when a rod or wire is stretched. For a long time, however, problems in the theory of elasticity were treated with the aid of this law alone, the first use of the law being made by Mariotte, who discovered it independently. He pointed out that, when a beam is bent, some of the longitudinal fibres are stretched and others contracted.

Bending of Rods.—This idea was developed by Jacques (Jakob, James) Bernoulli and Leonhard Euler into a theory of thin elastic rods, which involved the idea of a *couple* whose moment resists the *bending moment* and is proportional at each place to the curvature of the rod when bent. If the deflection y at a distance x from one end of the rod is small, the equation for the bending moment M is approximately

$$M=EI\frac{d^2y}{dx^2},$$

where EI is a constant called the *flexural rigidity* of the beam, E is Young's modulus for the material and I is a constant depending on the shape of the cross-section of the rod. In the case of a rod, of length l, free to turn about its ends and bent by forces acting along the line joining these ends, the bending moment (fig. 1) is $-yP$, and this is balanced by the resisting moment if

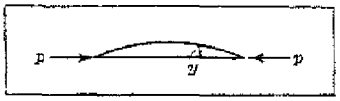


FIG. 1

$$EI\frac{d^2y}{dx^2}+Py=0.$$

Since y is zero when $x=0$ and when $x=1$, an appropriate solution is $y=A\sin\alpha x$, where $EI\alpha^2=P$ and $A\sin\alpha l=0$.

The last equation gives either $A=0$ or $\alpha l=n\pi$, where n is an integer. A more complete theory, in which an exact expression for the curvature is used, indicates that the straight form, given by $A=0$, is stable if $Pl^2<\pi^2EI$ and unstable if $Pl^2\geqq\pi^2EI$. In the latter case a bent form, such as that shown in fig. 1 is stable. This result can be extended, with suitable modifications, to columns and frameworks supported and loaded in various ways. The fact that the criterion for the failure of a rod, through instability of the straight form, depends upon the modulus E adds to the importance of this modulus as a physical quantity. The theory has been confirmed by the very careful experiments of Andrew Robertson. In practice a rod generally buckles under a load less than Euler's critical load, because the load is badly centred or because the rod has a slight initial curvature.

In the theory of the flexure of a thick beam, given by C. A. Coulomb, a line through the centroid of the cross-section, called the *neutral line*, is found to possess the property that the extension of a longitudinal fibre through a point Q of the section is represented by Cy, where y is the distance of Q from the neutral line and C is the curvature of the line of centroids at the position of this section. This relation is derived on the assumption that the cross-sections remain plane after bending.

The couple required to maintain flexure is then parallel to the plane of bending if $\int\int xydxdy=0$, where x is measured parallel to the neutral line. The couple is then given by the formula

$$M=\int\int(ECy)ydxdy=ECI,$$

where I is the moment of inertia of the cross-section of the beam about the neutral axis. The stress in the fibre under consideration is a tension or compression, according as y is positive or negative, it is given by the quantity ECy which may be expressed in the more convenient form My/I. There may be an additional longitudinal stress in the fibre due to longitudinal end loads. If the total stress in a fibre is greater than the material can sustain there will be rupture. When the problem of flexure is treated by more exact methods, it is found that the bending moment is not always proportional to the curvature of the line of centroids. This was first noted by Karl Pearson, for a special distribution of lateral loads. In the case treated by Barré de Saint Venant, in which the proportionality was confirmed, the bending was supposed to be produced by forces applied to the terminal sections. The propor

linearity fails even in this case if the beam is a very thin tube and consequently capable of large displacements. A theory developed for these conditions by L. G. Brazier gives a relation between bending moment and curvature of the type shown in fig. 2. If the bending moment is increased above the maximum value, corresponding to the point A, the beam must collapse. This is a new form of instability, and is an indication of the new results which may be expected from the general theory of elastic stability which has been developed by R. V. Southwell and applied to rods, tubes and plates.

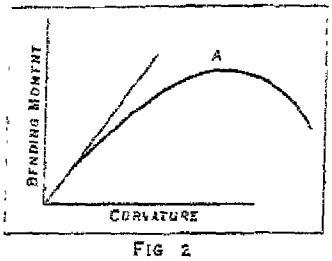


FIG. 2

Torsion and Shearing Stress.—The advantage of using the idea of stress instead of that of force is seen again from a consideration of the torsion of a shaft of length l. If θ is the angular displacement of one end relative to the other, and T the total twisting couple transmitted along the shaft, there is, for small values of θ, a relation of type

$$lT = K\theta,$$

where K is a constant which may be called the *torsional rigidity* of the shaft. This constant K is not, however, a physical constant for the material; it depends in a rather complicated way on the shape and size of the cross-section. Cauchy's theory showed that, in the case of a cylindrical shaft of uniform cross-section, K could be written in the form μJ, where J is the moment of inertia of the cross-sectional area about the axis of the cylinder and μ is a physical constant called the *rigidity* of the material. Saint Venant later gave a general theory of torsion, in which K has the same form as before except that J is now a geometrical constant, the determination of which for a given section depends on the solution of a problem of potential theory. The stress which, in this theory, is supposed to be transmitted across any element of area of a cross-section, is a *shearing stress, i.e.*, a stress derived from a force tangential to the area. This stress is expressed in terms of geometrical quantities by means of an extension of Hooke's Law appropriate for shearing stresses. This and other extensions of Hooke's Law will be given later when the ideas of stress and strain are made more definite. A mechanical method of determining K by means of a soap film stretched across a hole whose shape is the same as that of the cross-section of the shaft has been developed by A. A. Griffith and Geoffrey I. Taylor from a suggestion made by Ludwig Prandtl.

The Spiral Spring.—In 1848 James Thomson pointed out that the action of an ordinary spiral spring of circular cross-section depends mainly on torsion. The spring consists of a thin wire coiled into a helix of small pitch and radius c. When one end is fixed at a point O and the other attached to a weight W, it may be assumed that the axis of the coil is vertical and along the line OW. The twisting moment is then Wc, and the twist for a length l of coil is given approximately by the equation

$$lWc = K\theta.$$

The vertical displacement due to a twist $\theta\delta s/l$ in an element of length δs is $c\theta\delta s/l$. The total vertical displacement is therefore

$$c\theta = lWc^2/K.$$

There is no appreciable horizontal displacement of the weight, because the horizontal components due to the different elements will on the whole neutralize one another. Unless the pitch is small it is necessary in a more exact theory to take into consideration the bending moment and the flexural rigidity. The spring then tends to uncoil when stretched.

Units of Stress.—The c.g.s. unit of one dyne per square centimetre is rather small, and so a unit of one kilogram per square centimetre is used by many scientists. This unit will be denoted here by the symbol κ. Other convenient symbols which will also be used are τ for a stress of one ton per square inch, π for a stress of one pound per square inch and α for a unit pressure of one atmosphere. The transformation from one unit to another may be made with the aid of the relations

$$1000\alpha = 6{\cdot}5611\tau = 1470\pi = 1033\kappa = 1{\cdot}013 \times 10^9 \text{ C.G.S. units.}$$

The unit used in the International Critical Tables is one kilo megabyre, a megabyre being equal to $14{\cdot}5\pi$. Young's modulus for steel is a little greater than $13{,}200\tau$, consequently a tensional stress of $13{\cdot}2\tau$ will produce an extension of only about 0·001.

LIMITS OF ELASTICITY

Behaviour of a Substance Under Great Stress.—When a rod or wire has been stretched by a load, it recovers its original length and elasticity after the removal of the load, provided the stress produced by the load does not exceed a certain threshold value. This value is called the *elastic limit;* it generally gives very closely the limit of the range for which the strain is proportional to the stress, but may be slightly less than the proportional limit. With other kinds of stress the reverse may be the case. In Albert A. Michelson's experiments with twisted prisms the elastic strain produced by a stress p was found to be given by an expression of type Cpe^{hp}, where C and h are constants, while in P. W. Bridgman's experiments with substances subjected to hydrostatic pressures up to $12{,}000\kappa$ no elastic limit was detected, though there was always a limit of proportionality. As the pressure increases the compressibility decreases, the decrease for solids being generally less than for liquids.

With stresses beyond the elastic limit the behaviour is different for different substances, but generally the material becomes plastic when the load is applied, and the magnitude of the extension corresponding to a given load is indefinite and varies with the time. With a sufficiently large load the extension may increase with time in such a manner as to lead to rupture; with a smaller load the rate of increase, after quickly reaching a maximum value may gradually decrease to zero, just as if the motion were resisted by a kind of viscous drag. In this case a state of plastic equilibrium is approached. On the removal of the load the rod may not return to its original length, but may assume a slightly greater length. Sometimes the old or a new length is approached gradually, as if a viscous drag were again operative. This gradual creeping to a different length is called *elastic afterworking;* it was discovered by Wilhelm Weber in 1835.

If, after receiving a permanent set or deformation, a rod is reloaded, the strain may not be exactly proportional to the stress, but in some cases it is, and the proportional limit may be either greater or less than before. Sometimes the proportional limit is surprisingly low, but if the rod be allowed to rest for some days after the overstrain it recovers the property of linear elasticity. The stress at which the strain begins to increase very rapidly as the load is increased is called the *yield point.* For mild steel it may be about 18τ. The cross-section of the bar now diminishes in area, and just before rupture a narrow neck forms. The extension may then be about 30·6% and the reduction in area 67·4%.

In order to avoid calculation of the stress at each stage, engineers generally use a load-extension diagram in preference to a stress-strain diagram, and the stress at rupture, or *ultimate strength,* is a nominal stress calculated on the basis of the original cross-section. The actual stress is much greater than this; and it increases right up to the moment of rupture, while the load may actually decrease after the yield point has been passed. The ultimate strength of ordinary mild steel is about 30τ, that of piano wire about 120τ, while the ultimate strength of wood is generally less than 8τ.

The Principle of Least Work.—The stresses in the members of an over-rigid, that is a redundant, framework of elastic rods may generally be obtained by means of the principle of least work introduced by L. F. Menabrea and C. A. Castigliano. The method is to represent the stresses in a certain number of rods by algebraic symbols, the number being just sufficient to determine uniquely the stresses in the remaining rods when the framework is acted upon by external forces which, if compounded together, would form a system in equilibrium. The total strain energy of the framework is then calculated by summation, using the theorem that the strain energy of a rod of length l and uniform cross-sectional area A is $lF^2/2EA$, where F is the force acting along the rod and E is Young's modulus. This is in fact just l

times the area under the curve in the force extension diagram and so the volume of the rod multiplied by the area under the curve in the stress strain diagram. The values to be given to the algebraic symbols are now those which will make the total strain energy a minimum. The conditions for a minimum take the form of linear algebraic equations with a single set of solutions.

The stresses thus found do not necessarily form a physically possible system, for it may happen that the calculated stress in one or more of the rods exceeds the proportional limit. One method of treating the problem in such a case is to make the simplifying assumption that, when the stress in a rod reaches a certain yield point, it cannot exceed this value. Assuming that certain rods behave as plastic and the rest as elastic members, the stresses in the plastic rods are given by the known yield points, while the stresses in the elastic rods may be determined by the methods of statics or by an application of the principle of least work.

The stresses determined by the ordinary methods of statics or by the principle of least work may fail to represent a physical possible system for another reason. If the stress in a member is compressive and is greater than a certain critical value, the member will buckle. This critical value depends on the modulus E, and may be less than the yield point of the material. For some purposes it is useful to compare an elastic solid with a structure of elastic rods, and one of the important problems of the theory of elasticity is the determination of the critical loads for struts, structures and elastic plates of various shapes. These loads may be expected in general to depend, not only upon E, but also upon the other elastic constants just as in the case of a structure they depend upon the geometrical form. In some cases the problem can be treated by the elementary methods, in which the displacements of particles are treated as small, but for a full elucidation of some points a more exact theory is needed.

The Growth of the Structure Theory.—In the 17th and 18th centuries some problems relating to the bending and vibration of beams and columns were partially solved, although there was then no general theory of elasticity. The treatment of other problems was, however, erroneous and the need of a comprehensive theory became apparent. Curiously enough the general equations of the mathematical theory of elasticity originated, not from the more or less empirical attempts to solve special problems but from a combination of definite mathematical hypotheses with certain speculations regarding the structure of matter.

Following up Boyle's idea of particles of air endowed with the properties of a spring, Sir Isaac Newton endeavoured to explain the simple proportionality between air pressure and density by introducing the idea of a repulsive force between two molecules depending only on their mutual distance. Newton actually used an inverse distance law, but was careful to state that the force must be regarded as operative only when the distance does not exceed a certain length. An atom or molecule was thus regarded as having a more or less definite sphere of action, and attractive forces of various intensities were regarded as the cause of chemical action. The idea of molecular attractive forces with a limited range of action was used also by P. S. Laplace in his theory of surface tension.

The use in physics of forces depending only on the distance and acting only over a definite range had thus already received some sanction when C. L. M. H. Navier used the idea in 1821 to obtain a set of general equations for the equilibrium and vibration of an elastic solid. Navier's molecules, like those of R. G. Boscovich, were practically centres of force, and his equations for an isotropic substance involved only a single elastic constant analogous to Young's modulus. The theory was carried a step further by Cauchy, who imagined the molecules to form a homogeneous assemblage or lattice. He thus obtained a generalization of Hooke's law involving 15 elastic constants, and regarded it as applicable to any crystalline or aeolotropic substance.

The need for a greater number of elastic constants for both crystalline and isotropic bodies was realized by S. D. Poisson who, prior to Navier's work, had used the Newtonian ideas in some work on the equilibrium of an elastic surface. Poisson proposed to go back to the Newtonian conception of a molecule with a definite shape and size and to consider the effect of changes in the orientation as well as the position of the molecules of an elastic body. The calculations were completed by Woldemar Voigt in 1887. Shortly afterwards Lord Kelvin (William Thomson), in an attempt to raise the number of elastic constants for a crystalline substance to 21, represented a molecule by a pair of centres of force. This work has been extended by Max Born and his co-workers. By using a number of centres of force as the structural element, it is possible to calculate the elastic constants with fair accuracy and to estimate also the thermal characteristics of a crystalline substance. The hypotheses upon which the structure theory is based are only rough approximations to the truth, and so the general equations of elasticity have also been derived from general mechanical and thermodynamical principles, a solid body being treated as continuous.

THEORY OF STRAIN

In the general theory of strain, let P, Q be two neighbouring points of an elastic body, and P', Q', the new positions of these points when the body is deformed. Using a system of rectangular axes to specify the positions of these points, and denoting their co-ordinates by (x, y, z), $(x+dx, y+dy, z+dz)$, (x', y', z') $(x'+dx', y'+dy', z'+dz')$ respectively, the differences

$$u=x'-x, \qquad v=y'-y, \qquad w=z'-z,$$
$$u+du=x'+dx'-x-dx,$$
$$v+dv=y'+dy'-y-dy,$$
$$w+dw=z'+dz'-z-dz$$

are regarded as the *component displacements* of the points respectively.

If now ds represents the small distance PQ, and ds' the small distance $P'Q'$, the ratio of $ds'-ds$ to ds is defined to be the *strain* of the element ds. In the mathematical theory, a limiting process is supposed to be carried out in which the length PQ is made indefinitely small, and the strain is defined in very much the same way as a differential coefficient. The strain is then associated with the point P, but depends upon the direction of the element PQ. Indeed, if the space occupied by the body is assumed to be Euclidean before and after deformation, the relations

$$ds'^2=dx'^2+dy'^2+dz'^2, \quad ds^2=dx^2+dy^2+dz^2,$$

give rise to a relation of type

$$ds'^2=ds^2+2(adx^2+bdy^2+cdz^2+2fdydz+2gdzdx+2hdxdy),$$

in which the coefficients a, b, c, $2f$, $2g$, $2h$ depend on the partial derivatives of the displacements u, v, w. These coefficients are called the six components of strain, and may be rewritten as s_1, s_2, s_3, s_4, s_5, s_6, or as e_{xx}, e_{yy}, e_{zz}, e_{yz}, e_{zx}, e_{xy}, according to circumstances, one notation being sometimes more convenient than another.

The six components of strain are connected by certain relations which imply that the expression for ds'^2 is suitable for the representation of the square of the element of length in Euclidean space (x, y, z, are regarded now as generalized co-ordinates). When the squares and products of the partial derivatives are so small in comparison with the derivatives themselves that they may be neglected, the expressions for the components of strain may be written in the form:—

$$a=\frac{\partial u}{\partial x}, \qquad 2f=\frac{\partial w}{\partial y}+\frac{\partial v}{\partial z};$$
$$b=\frac{\partial v}{\partial y}, \qquad 2g=\frac{\partial u}{\partial z}+\frac{\partial w}{\partial x};$$
$$c=\frac{\partial w}{\partial z}, \qquad 2h=\frac{\partial v}{\partial x}+\frac{\partial u}{\partial y};$$

and the relations are easily found. These are called the *conditions of compatibility*.

The strain represented by a single component of type a, the other components being zero, is a *simple extension* parallel to the axis of x. The strain represented by the single component $2f$

If other components being zero, is called a *shearing strain*. When f is constant this shearing strain may be regarded as made up of two simple shears for which the corresponding displacements are respectively

$$u=0, \quad v=0, \quad w=fy$$
$$u=0, \quad v=fz, \quad w=0.$$

The displacement in a simple shear may be regarded as composed of two parts: viz., a rotational displacement,

$$u=0 \qquad v=-\tfrac{1}{2}fx, \qquad w=\tfrac{1}{2}fy, \qquad \omega=\tfrac{1}{2}f,$$

for which there is no corresponding strain, and the displacement

$$u=0, \qquad v=\tfrac{1}{2}fx, \qquad w=\tfrac{1}{2}fy,$$

for which the three components of rotation defined by the equations

$$2\xi=\frac{\partial w}{\partial y}-\frac{\partial v}{\partial z}, \qquad 2\eta=\frac{\partial u}{\partial z}-\frac{\partial w}{\partial x}, \qquad 2\zeta=\frac{\partial v}{\partial x}-\frac{\partial u}{\partial y}$$

are all zero. This resolution of a displacement into a rotation and an irrotational part has an analogue in the case when the strain is not constant, for we may write

$$du=(a\,dx+h\,dy+g\,dz)+(\eta\,dz-\zeta\,dy)$$
$$dv=(h\,dx+b\,dy+f\,dz)+(\zeta\,dx-\xi\,dz)$$
$$dw=(g\,dx+f\,dy+c\,dz)+(\xi\,dy-\eta\,dx).$$

Invariants.—When the axes of co-ordinates are changed, the six components of strain are changed also, but certain combinations of them remain unaltered in form. These invariants may be obtained by remarking that the ratio $ds':ds$ for any direction through P is inversely proportional to the central radius vector, in that direction, of the quadric surface whose equation in rectangular co-ordinates is

$$x^2+y^2+z^2+2(ax^2+by^2+cz^2+2fyz+2gzx+2hxy)=1;$$

the lengths of the principal axes of this quadric are consequently invariants. The principal axes of the quadric are called the principal axes of strain for the point P, and the extensions of a linear element for these directions are called the principal extensions ϵ_1, ϵ_2, ϵ_3. The values of $1+\epsilon_1$, $1+\epsilon_2$, $1+\epsilon_3$ are the positive square roots of the three values of k for which

$$\begin{vmatrix} 1+2a-k & 2h & 2g \\ 2h & 1+2b-k & 2f \\ 2g & 2f & 1+2c-k \end{vmatrix}=0.$$

The coefficients of the different powers of $\frac{1-k}{2}$ in this equation are naturally invariants. These invariants are respectively

$$I_1=a+b+c$$
$$I_2=bc-f^2+ca-g^2+ab-h^2$$
$$I_3=abc+2fgh-af^2-bg^2-ch^2.$$

An invariant expressible in terms of these is obtained by putting $k=0$ in the determinant. This invariant may be written, in an alternative form, as the square of a Jacobian

$$J^2=\left(\frac{\partial(x',y',z')}{\partial(x,y,z)}\right)^2=(1+\Delta)^2,$$

where Δ is a quantity called the *cubical dilatation*. When squares and products of the derivatives of u, v and w are neglected, the formula for the dilatation becomes simply

$$\Delta=\frac{\partial u}{\partial x}+\frac{\partial v}{\partial y}+\frac{\partial w}{\partial z}.$$

The quantity J represents the ratio of the volume of a small portion of the body after and before deformation. When the approximate expressions for the strains are adopted, it is clear that there is no change of volume in the shearing strain for which f is the only component different from zero.

The Strain Energy Function.—In 1837 George Green obtained a generalization of Hooke's law, suitable for the most general type of crystalline substance, by starting from the assumption that when the components of strain in a deformed body are defined by considering displacements from an initial state in which the body is free from strain, and consequently also free from stress, and when the components are also small, there is a strain energy function W which can be supposed to represent the density of strain energy at each point (x, y, z) of the body. In 1855 Lord Kelvin gave a thermodynamical argument which made Green's hypothesis seem plausible in two cases, first when the deformation takes place at a constant temperature and secondly when it takes place without loss of heat. Green assumed further that there is in general a relation of type

$$2W=\sum_{m=1}^{6}\sum_{n=1}^{6}c_{mn}s_m s_n,$$

where the coefficients c_{mn} are elastic constants characteristic of the material. For convenience it will be assumed that $c_{nm}=c_{mn}$; this may be done without loss of generality because the sum of these two quantities occurs as the coefficient of $s_m s_n$ in the complete expression for W.

Lord Kelvin's thermodynamical argument indicates that it is necessary to distinguish between two sets of elastic constants, the *isothermal* and the *adiabatic*; it also shows that the quantities

$$S_n=\frac{\partial W}{\partial s_n}=\sum_{m=1}^{6}c_{mn}s_m$$

specify the state of stress in the body. The relation

$$2W=s_1S_1+s_2S_2+s_3S_3+s_4S_4+s_5S_5+s_6S_6$$

is, in fact, a natural extension of the formula $2W=sS$ already obtained for the case in which there is only one component of stress which is constant throughout the body and of the nature of a simple tension.

The quantities $S_1, S_2, S_3, S_4, S_5, S_6$ may be regarded provisionally as the *six components of stress*. They are usually denoted by another set of symbols such as X_x, Y_y, Z_z, Y_z, Z_x, X_y, and this notation is completed by introducing quantities Z_y, X_z, Y_x defined by the relations $Z_y=Y_z$, $X_z=Z_x$, $Y_x=X_y$. The general expression for W is suitable for a crystalline body or a substance like wood, whose physical properties are related to certain definite directions in the material. For an isotropic substance, *i.e.*, a substance in which all directions are alike as far as structure is concerned, the expression for W should have the same form in all systems of rectangular co-ordinates, and so should depend only on the invariants I_1, I_2, I_3. The natural assumption is thus

$$2W=(\lambda+2\mu)I_1^2-4\mu I_2,$$

where λ and μ are elastic constants. The corresponding relations between stress and strain are now

$$X_x=\lambda\Delta+2\mu a, \qquad Y_z=2\mu f,$$
$$Y_y=\lambda\Delta+2\mu b, \qquad Z_x=2\mu g,$$
$$Z_z=\lambda\Delta+2\mu c, \qquad X_y=2\mu h;$$

where, as before, $\Delta=a+b+c$.

The relations between stress and strain may be solved for the components of strain giving, in particular,

$$Ea=X_x-\sigma(Y_y+Z_z)$$
$$Eb=Y_y-\sigma(Z_z+X_x)$$
$$Ec=Z_z-\sigma(X_x+Y_y),$$

where $$E=\frac{\mu(3\lambda+2\mu)}{\lambda+\mu}, \qquad \sigma=\frac{\lambda}{2(\lambda+\mu)}.$$

In these equations E is *Young's modulus*, σ is *Poisson's ratio*, μ is the *modulus of rigidity*, and the quantity $k=\lambda+\frac{2}{3}\mu$ is the *modulus of compression*. Under ordinary conditions the adiabatic constants for a solid substance are practically the same as the corresponding isothermal constants

Ela Co ta t

E is exp essed *in* unit of o

Substance	*E*	*σ*
Wrought iron	27–29	·28
Mild steel	29–31	
Cast iron	14–23	·28
Low carbon steel	28	
High carbon steel	27	
Aluminium (cast)	12·5	·34
Aluminium (wire)	18	
Duralumin	9·7–10·7	
Brass	12	·33
Copper	15	35
Glass	8–10 6	·23
Rubber	250–350π	·5
Spruce (15% moisture)	1·3	
Ash	1·46	
Oak	1·4	
Walnut	1·3–1·5	
Birch	1·8–1·95	
Mahogany	1·3–1 4	
Hickory	1·9	
Celluloid (nitrocellulose)	0·355	·41

It must be remembered that considerable differences are found in the elastic constants of different samples of nominally the same substance. The assumption that a metal is homogeneous and isotropic is not very accurate, for modern metallurgical studies have shown that metals which have been subjected to certain treatments may be composed of long narrow crystals which impart to a specimen of kind of fibrous structure. Much work has indeed been done recently on the strength and elastic properties of single crystals, and these are found to differ considerably from those of a solid composed of an aggregate of small crystals and an amorphous substance which binds them together. The fibrous structure of wood is well known and several elastic constants are really needed to describe its properties, and these depend largely upon the amount of moisture in the wood. The value of E generally used corresponds to tension along the grain.

EQUATIONS OF EQUILIBRIUM

From the Principle of Least Work.—The conditions for the equilibrium of an elastic solid deformed by given forces may be obtained from an earlier form of the principle of least work. Assuming, for simplicity, that the body is deformed only by surface tractions and that the displacements of points on the surface are prescribed, the internal displacements are supposed to be of such a nature that the total strain energy of the body is a minimum when the energy associated with the actual deformation is compared with the energy of a fictitious deformation consistent with the same surface displacements.

Giving arbitrary small increments to the component displacements u,v,w of a point (x,y,z), and assuming that the strains are so small that their expressions (1) may be used in the expression for the total energy, the Eulerian equations of the Calculus of Variations give in this case

$$L \equiv \frac{\partial X_x}{\partial x} + \frac{\partial X_y}{\partial y} + \frac{\partial X_z}{\partial z} = 0,$$

$$M \equiv \frac{\partial Y_x}{\partial x} + \frac{\partial Y_y}{\partial y} + \frac{\partial Y_z}{\partial z} = 0,$$

$$N \equiv \frac{\partial Z_x}{\partial x} + \frac{\partial Z_y}{\partial y} + \frac{\partial Z_z}{\partial z} = 0.$$

These will be regarded as the differential equations for the equilibrium of an element, of the body, which occupies the position (x,y,z).

The first equation gives

$$\int\int\int L\,dx\,dy\,dz = 0,$$

where the integration extends over an arbitrary portion of the body. Transforming this volume integral into a surface integral by the usual method, the resulting equation may be written in the form

$$\int\int (lX_x + mX_y + nX_z)\,dS = 0$$

where (l,m,n) are the direction cosines of the normal to the surface-element dS. The quantity under the integral sign is now interpreted to be the x-component of the surface traction acting across the surface element dS, while the quantity within brackets is regarded as the x-component of the stress across this element. Denoting this quantity by X, the preceding equation may be written in the form

$$\int\int X_\nu\,dS = 0,$$

and there are similar equations involving the y and z-components Y_ν, Z_ν. These may be regarded as three of the conditions of equilibrium of the surface tractions on the elements of the closed surface S. The other conditions for the equilibrium of these surface tractions are obtained by taking moments about the axes of co-ordinates; they are

$$\int\int (yZ_\nu - zY_\nu)\,dS = 0, \qquad \int\int (zX_\nu - xZ_\nu)\,dS = 0,$$
$$\int\int (xY_\nu - yX_\nu)\,dS = 0.$$

Transforming the surface integrals into volume integrals, it is found that the three equations are satisfied in virtue of the differential equations of equilibrium and the three equations

$$Y_z = Z_y, \qquad Z_x = X_z, \qquad X_y = Y_x$$

which were introduced to complete the notation.

With the present definition of stress, the stress components across an area perpendicular to the axis of x are X_x, Y_x, Z_x, while those across an area perpendicular to the axis of y are X_y, Y_y, Z_y. The equation $X_y = Y_x$ is interpreted as a relation between complementary shearing stresses. The usual convention in interpreting X_ν is that it is a stress exerted by the part of the body towards which the normal is drawn. It is clear from the definition that the component stress in the direction (l', m', n') across a plane at right angles to (l, m, n) is

$$l'(lX_x + mX_y + nX_z) + m'(lY_x + mY_y + nY_z) + n'(lZ_x + mZ_y + nZ_z).$$

The state of stress at a point (x,y,z) is thus completely specified by the six components of stress.

Body Forces.—When an elastic solid is acted upon by a body force like gravity, which acts right through the body, the equations of equilibrium take a more general form, and are of type

$$L + \rho X = 0,$$

where X is the x-component of the body force per unit mass. When the body is in motion the force of inertia may be treated as an additional body force, and the equations of motion are of type

$$L + \rho X = \rho \frac{\partial^2 u}{\partial t^2}.$$

These equations are particularly useful for a study of the vibrations of solid bodies and the propagation of waves through them.

It was shown by Poisson that there are two distinct velocities with which waves can be propagated without change of type through a homogeneous isotropic elastic solid. The so-called irrotational waves (or waves of compression) travel with velocity $\sqrt{(\lambda + 2\mu)/\rho}$, while the equivoluminal waves (or waves of shear) travel with velocity $\sqrt{\mu/\rho}$. Lord Rayleigh (John William Strutt, 3rd baron) discovered that a type of surface wave, compounded in a rather complex way from waves of the two types, can travel with a velocity slightly less than that of the equivoluminal waves. The vibrations of elastic solids are of great interest in the theory of sound and in the design of engineering structures

PROBLEMS IN THEORY

Simple Distributions of Stress.—Examples will now be given to indicate very briefly some of the steps which must be taken in the solution of problems in the theory of elasticity. If T is a constant, the equations are satisfied by the stress components

$$X_x = T, \qquad Y_y = Z_z = Y_z = Z_x = X_y = 0,$$

and the corresponding strains are given by the equations

$$Ea = T, \qquad Eb = Ec = \quad \sigma T$$

[illegible] should be a [illegible] corresponding to the distribution of strain. In the present case it is easily seen that the expressions

$$u=ax, \qquad v=by, \qquad w=cz,$$

satisfy requirements but generally it is necessary to make use of the conditions of compatibility which lead to a set of differential equations for the stresses. In this example the lateral contraction $-b$ is σ times the longitudinal extension a, and so a physical meaning is found for Poisson's ratio. The state of stress may be supposed to exist in a cylindrical rod whose axis and generators are parallel to the x-axis. The curved surface of the rod is then free from surface tractions, but the end surface must be regarded as acted upon by uniformly distributed normal tractions.

If p is a constant, the stress-components

$$X_x=Y_y=Z_z=-p,$$
$$Y_z=Z_x=X_y=0,$$

also satisfy the equations and give

$$a=b=c=-p/(3\lambda+2\mu), \qquad \Delta=-p/k.$$

If l,m,n are the direction cosines of the normal to a surface element of the boundary of the solid, the components of stress across this element are $-lp,-mp,-np$; the stress is thus a *uniform normal pressure*. It is easily seen that displacements corresponding to the strains can be found, and so the stress distribution can exist in a body subjected to a constant hydrostatic pressure p. The case in which p varies with position and there are body forces is easily treated. This example indicates clearly why k is called the modulus of compression.

If S is a constant, the stress components

$$X_x=Y_y=Z_z=Y_z=Z_x=0, \qquad X_y=S,$$

satisfy the conditions and give

$$a=b=c=f=g=0, \qquad 2h=S/\mu.$$

The displacements, $u=2hy$, $v=0$, $w=0$, corresponding to a simple shear are possible in connection with this distribution of strain, and the reason for calling μ the *modulus of shear* or *rigidity* of the material is apparent. It is sometimes convenient to resolve a given distribution of stress into a uniform normal pressure, for which $3p=-(X_x+Y_y+Z_z)$, and a residual distribution of shearing stresses which would by themselves produce no volume change. This gives a general definition of pressure.

The Thin Plate.—The deformation of a thin plate bounded by plane surfaces $z=\pm h$ may in some cases be discussed with the aid of a theory of generalized plane stress, due to Louis Napoleon George Filon. It is assumed in this theory that Z_z is everywhere zero, and that the faces $z=\pm h$ are free from stress. Average values of u, X_x, etc., are defined by means of equations such as

$$2h\bar{u}=\int_{-h}^{h} u\,dz,$$

the bar over a symbol denoting that an average has been taken. Since X_z and Y_z vanish at $z=\pm h$, it is found that

$$\frac{\partial \bar{X}_x}{\partial x}+\frac{\partial \bar{X}_y}{\partial y}=0, \qquad \frac{\partial \bar{Y}_y}{\partial x}+\frac{\partial \bar{Y}_x}{\partial y}=0;$$

and these equations may be satisfied, in the same way as in the earlier theory of Sir George Airy, by writing

$$\bar{X}_x=\frac{\partial^2\chi}{\partial y^2}, \qquad \bar{Y}_y=\frac{\partial^2\chi}{\partial x^2}, \qquad \bar{X}_y=-\frac{\partial^2\chi}{\partial x\partial y}.$$

The differential equation for χ may be found by first observing that

$$0=Z_z=\lambda\Delta+2\mu\frac{\partial w}{\partial z}=(\lambda+2\mu)\Delta-2\mu\left(\frac{\partial u}{\partial x}+\frac{\partial v}{\partial y}\right).$$

[illegible] e o averag g

$$(\lambda+2\mu)\bar{\Delta}=2\mu\left(\frac{\partial \bar{u}}{\partial x}+\frac{\partial \bar{v}}{\partial y}\right)$$

whilst the relations between stress and strai

$$\bar{X}_x=\lambda\bar{\Delta}+2\mu\frac{\partial \bar{u}}{\partial x}; \qquad \bar{Y}_y=\lambda\bar{\Delta}+2\mu\frac{\partial \bar{v}}{\partial y}; \qquad \bar{Y}$$

The elimination of u and v now gives Airy's d

$$\frac{\partial^4\chi}{\partial x^4}+2\frac{\partial^4\chi}{\partial x^2\partial y^2}+\frac{\partial^4\chi}{\partial y^4}=0$$

The quantities X_x, Y_y, X_y may be regarded

ponents of stress, and $\frac{\partial \bar{u}}{\partial x}$, $\frac{\partial \bar{v}}{\partial y}$, $\frac{\partial \bar{v}}{\partial x}+\frac{\partial \bar{u}}{\partial y}$ a

ponents of strain. At each point of the plat cipal axes of generalized strain, and these m as principal axes of generalized stress. If thes of co-ordinates $\bar{X}_y=0$, and $\bar{X}_x$, $\bar{Y}_y$ become t which will be denoted by the symbols P and (

Photoelastic Methods.—Many deductio have been confirmed by the photoelastic n based upon the discovery, made by Sir Davi that, when a piece of glass is loaded and view under suitable conditions, it shows brilliant c the fact that the glass has changed its optica become doubly refracting. Brewster sugges distribution in masonry bridges might be inves ing glass models, and after many years the lowed up by Augustin Mesnager in Paris. B paratus devised by E. G. Coker it is possibl accuracy of about 2%, the stress distributio of stress loads, in any body which can be re model of transparent material stressed in its

Tests are frequently made with models c celluloid, but a new transparent material, "p pears to be superior to celluloid, has recentl Tokyo by Z. Tuzi. The model is illuminate light, and an image of it projected on the screer whose plane of polarization is perpendicular izer. All points at which the principal stress to or at right-angles to the plane of polarizat determined, and, by rotating both polarizer taneously, the directions of the principal stre every point of the specimen. The difference by the colour shown at the point in questio illuminated by circularly polarized light. If e as in simple tension or compression, the inten derived from a colour scale, such as that gi table, or may be derived by comparison wi member of the same material subjected to a k the maximum stresses occur at the inner an material, and when these surfaces are not stress across a line at right angles to the bc off at once.

Colour Scale

Order	Colour
I.	Black Grey White Straw Orange Brick Red Purple Blue
II.	Yellow Red Purple

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ELASTICITY OF DEMAND. In economics, a term used to describe the condition of the market for a given commodity in respect of the reaction of demand to supply. Marshall (*Principles of Economics*) puts it that "the elasticity of demand in a market is great or small according as the amount demanded increases much or little for a given fall in price, and diminishes much or little for a given rise in price."

A commodity may at one and the same time, in the same market, be in "elastic demand" by the poor and "inelastic demand" by the rich. Thus, if bananas fell in price to ten a penny, the demand of the well-to-do would not alter, because they would need no more than when bananas were a penny or twopence each, but the demand of the poor would be "elastic," and a greatly increased quantity would be sold. For a discussion of supply and demand, *see* ECONOMICS.

ELATERITE, also termed elastic bitumen and mineral caoutchouc, an asphaltic pyrobitumen originally discovered in the Odin lead mines at Castleton, Derbyshire. It occurs in a few other localities, but always in small quantities and is merely of scientific interest. It varies somewhat in consistency, but is typically soft and elastic, often closely resembling india-rubber, and is a derivative of petroleum. A substance of similar physical character is found in the Coorong district of South Australia and is known as coorongite, but some doubt still exists as to whether this is a derivative of petroleum or a vegetable product.

ELATERIUM, a drug consisting of a sediment deposited by the juice of the fruit of *Ecballium Elaterium* (family Cucurbitaceae), the squirting cucumber, a native of the Mediterranean region. The plant grows like the vegetable marrow. The fruit resembles a small cucumber, and when ripe is turgid and separates easily from the stalk. On removal of the stalk the contents of the fruit are squirted through the aperture by the sudden contraction of the wall of the fruit. To prepare the drug the fruit is sliced lengthwise and slightly pressed, the greenish and slightly turbid juice thus obtained is strained and the deposit of elaterium formed after a few hours is collected on linen, rapidly drained, and dried on porous tiles at a gentle heat. Elaterium is met with in commerce in light, thin, friable, flat or slightly incurved opaque cakes, of a greyish-green colour, bitter taste, and tea-like smell.

The drug is soluble in alcohol, but insoluble in water and ether. The official dose is 1/10—½ grain, and the British pharmacopoeia directs that the drug is to contain from 20 to 25% of the active principle elaterinum or elaterin. Elaterin is extracted from elaterium by chloroform and then precipitated by ether as colourless scales. It has the formula $C_{20}H_{28}O_5$. The dose is 1/40—1/10 grain. Elaterium is the most active hydragogue purgative known, causing also much depression and violent griping. When injected subcutaneously it is inert, as its action is dependent upon its admixture with the bile. It must not be used except in urgent cases.

ELBA (Gr. Αἰθαλία; Lat. *Ilva*), island off the west coast of Italy, province of Leghorn, from which it is 45 m. south, and 7 m. southwest of Piombino, the nearest point of the mainland. Pop. (1921) 26,164. It is about 19 m. long, 6½ m. broad, and 140 sq.m. in area; its highest point is 3,340 ft. (Monte Capanne). It forms, like Giglio and Monte Cristo, part of a sunken mountain range extending towards Corsica and Sardinia.

The oldest rocks are schist and serpentine overlaid in the eastern part by Silurian and Devonian beds. The Permian may be represented, but the Trias is absent, and in general the older Palaeozoic rocks are overlaid directly by the Rhaetic and Lias. The Liassic beds are often metamorphosed and the limestones contain garnet and wollastonite. The Eocene shows nummulitic limestone, sandstone and schist; Miocene and Pliocene are absent. Serpentines, peridotites and diabases are interstratified with the Eocene deposits; granite, intruded through the Eocene beds, is associated with a pegmatite containing tourmaline and cassiterite. The celebrated iron ore is of Tertiary age and occurs indifferently in all the older rocks. These ores were worked by the ancients. Some of the ore is now dealt with on the island itself and some at Piombino. The total iron production was 439,000 tons in 1925 (88% of the total for Italy). Granite was quarried by the Romans, but is not now much worked.

Parts of the island are fertile, and cultivation of vines, and tunny and sardine fishery employ part of the population. The capital is Portoferraio—pop. (1921) 6,018—in the centre of the north coast, enclosed by a mountain amphitheatre, the slopes of which are covered with villas and gardens. This is the best harbour, the ancient *Portus Argous*. The town was built and fortified by Cosimo I. in 1548, who called it Cosmopolis. Above the harbour, is the palace of Napoleon I., and 4 m. to the south-west is his villa; on the north slope of Monte Capanne is another of his houses. At Le Grotte, between Portoferraio and Rio dell' Elba, and at Capo Castello are Roman ruins.

Elba was famous for its mines in early times, and the smelting furnaces gave it its Greek name of Αἰθαλία ("soot island"). In 453 B.C. Elba was devastated by a Syracusan squadron. From the 11th to the 14th century it belonged to Pisa, and in 1399 came under the dukes of Piombino. In 1548 it was ceded by them to Cosimo I. of Florence. In 1596 Porto Longone was taken by Philip III. of Spain, and retained until 1709, when it was ceded to Naples. In 1802 the island was given to France. On Napoleon's deposition, the island was ceded to him with full sovereign rights, and he resided there from May 5, 1814, to Feb. 26, 1815. After his fall it was restored to Tuscany, and passed with it to Italy in 1860.

ELBASSAN, a town of Albania. Pop. (1924) about 16,000, of whom 85% are Muslims and the remainder Orthodox and Roman Catholics. Elbassan lies on a fertile plain amid wooded country and is surrounded by gardens; the climate is healthy and there is an excellent water supply. The Catholic Albanians live in the centre of the town within the ruined castle, outside are the Muslims, and beyond them the Vlachs who belong to the Orthodox Church. The town is fairly prosperous, with good public buildings and a large bazaar where rather shoddy foreign tinware, crockery and linen and cloth goods are sold. Olives and maize are cultivated. The valleys of the Semeni and Devoli afford communication with Berat, and there is a road to Durazzo, and also a light railway built by the Austrians. Elbassan was captured by the Serbs during the Balkan Wars (1912–13) but afterwards restored to Albania.

ELBE. The *Elbe* (*Albis* of the Romans, *Labe* of the Czechs), is a river of Central Europe, rising in Bohemia on the southern side of the Riesengebirge at an altitude of about 4,600 ft. The Elbseifen, after plunging down the 140 ft. of the Elbefall unites with the steep torrential Weisswasser at Mädelstegbaude. Thereafter the united stream of the Elbe pursues a southerly course, turning sharply to the west at Pardubitz and at Kolin bends gradually towards the north west. A little above Brandeis it picks up the Iser and at Melnik the volume of the stream is more than doubled by the Vltava (Moldau) which runs northwards through the heart of Bohemia; at Leitmeritz the Elbe receives the Eger. Thus augmented the Elbe carves a path through the basaltic mass of the Mittelgebirge through a deep narrow rocky gorge, then the river winds through the fantastically sculptured mountains of "Saxon Switzerland" (Bastei).

Shortly after crossing the Czechoslovakian frontier the stream assumes a north westerly direction, which it preserves on the whole all the way to the North Sea. After leaving Saxon Switzerland at Pirna, the Elbe rolls through Dresden, afterwards entering on its long journey across the north German plain, touching amongst other places, Wittenberg, Magdeburg and Hamburg, and gathering the waters of Mulde and Saale from the left and those of Schwarze Elster, Havel and Elde from the right. Above Hamburg the stream divides into Norder and Süder Elbe, linked together by several cross channels. At Blankenese, seven miles below Hamburg, all these branches have been re-united, and the Elbe, with a width of 4–9 miles between bank and bank, travels on between the green marshes of Holstein and Hanover until it becomes merged in the North Sea off Cuxhaven. The width is about

a Kolin, 500 ft. at the mouth of the Vltava 960 ft. at Dresden and over 1000 ft. at Magdeburg. From Dresden to the sea the river has a total fall of only 360 ft. over a distance of about 430 miles. The tide advances as far as Geesthacht (100 miles from the sea). The river is navigable as far as Melnik (525 miles, of which 67 in Czechoslovakia). Its total length is 725 miles (190 in Czechoslovakia). The area of the drainage basin is estimated at 56 000 square miles.

Navigability.—Since 1842, but more especially since 1871, the riparian states have carried out works to increase the navigability of the Elbe. From the point of view of navigation on the Elbe-Vltava system, three different sections are to be distinguished. (1) The canalised section, (2) the regulated section and (3) the maritime section. The canalised section includes the Vltava from Prague to Melnik and the Elbe from Melnik to Lovosice. Shortly the canalisation will go as far as Usti, after finishing the Strekov dam. In this section, 115 km. long, the navigable channel has a minimum depth of 2m10. The normal largest type of barge now in use has a carrying capacity of 900 tons. The draft at full load does not exceed 1m80. This section of the river therefore meets all traffic requirements. The canalisation is effected by locks and movable dams, the latter so designed that in times of flood or frost they can be dropped flat on the bottom of the river. The regulated section between Usti and Hamburg, 649 km. long, has been regulated at middle water. The depth of the navigable channel varies according to the water level, which is dependent on general hydraulic conditions. The loading capacity of 900 ton barges can be fully utilized during about 220 days and for ⅔ during about 80 days. (In 1925, owing to shortage of water, this period was considerably less.) The German programme for improvement works establishes a depth of 1m.25 below and 1m.10 above the Saale mouth at the lowest water level. Czechoslovakia also contemplates the improvement of its section below Usti. The maritime section between Hamburg, Harburg and the sea, long about 150 km., has an average depth of 9m.50. (Near Oste-bank 8 m. below average low water level.) Unremitting efforts are being made to meet the constantly increasing draught of vessels. All vessels can go up to Hamburg at high water.

Canals of the Elbe River System.—During the last quarter of the 19th century some 100 miles of canal were dug for the purpose of connecting the Elbe through the Havel and the Spree with the Oder system; the Spree has also been canalized for 28 miles. Since 1900 Lübeck has been in direct communication with the Elbe to Lawenburg by the Elbe-Trave Canal, length 42 miles, width 12 ft. at the bottom and 105 to 126 ft. at the top; minimum depth 8⅛ ft., equipped with 7 locks each 80 m. long, and with a gate width of 12 m. (See *Der Bau des Elbe-Trave Canals und seine Vorgeschichte* [Lübeck 1900], Dr. Emil Hammermann *Der Elbe-Trave-Kanal* [Jena, Fischer, 1914].) The Mittelland Canal (*see* INLAND WATER TRANSPORT), last part (Hanover-Magdeburg) of which is now under construction, will establish water communication between the Elbe and Rhine systems.

Traffic.—The traffic on the Elbe cannot rival the Rhine, particularly in so far as heavy goods transport is concerned. The principal heavy goods on the Elbe are lignite and potash. The Elbe has not many important tributaries (only Saale and Havel are of some importance). The main sphere of activity for navigation is therefore the river itself. This fact increases the importance of the transhipment places for the hinterland. It is to be expected that the completion of the Mittelland Canal and of the canalisation of the Saale with canals to Leopoldshall-Leipzig, will tend to diminish this importance, particularly with regard to transhipment places on the middle Elbe. The principal commodities in Elbe traffic are potash and other salts, sugar, paper, ore, glass and glassware, raw steel, bauxite, iron pyrites, phosphates, timber, cereals, fertilizers, oils, fats and beer.

Before the World War the Elbe carried considerably more goods than the competing railways, the general direction of which is parallel to the river, and this notwithstanding an important number of exceptional tariffs for consignments by rail to and from sea ports. Out of Hamburg export by sea of goods from the upper Elbe region 5·2 million arrived by rail: 4·6 million tons by water (47 per cent). Out of Hamburg import of goods for the upper Elbe region 2·6 million tons went by rail, 5·8 million tons (69%) by water. Corresponding figures for the present period are 1925 (1927): *exports*, rail 3·9 million tons (5·9), water 3·2 (3·5) or 45% (37%): *imports*, rail 3·3 million tons (3·9) water 3·1 (4·6) or 48% (54%). These figures show that rail competition has become important, but it should be observed that whilst the proportion of water-traffic in down-stream direction is still decreasing water-traffic in up-stream direction shows an increase both absolute and relative. Before the war there were several competing railway systems. Thus the Saxon railways favoured transhipment in Saxon ports by special rates, which to a certain degree counter-balanced the influence of exceptional seaport rates. All exceptional tariffs were abolished during the war. Afterwards the peace treaties prohibited Germany for a time from granting special tariffs either for river or seaports.

After the World War the various German railway systems were amalgamated and there no longer existed an interest for the railway to favour transhipment in river ports. Moreover in 1920 the German railways introduced the system of long distance rebate rates and sometime ago re-established exceptional tariffs for seaports, but not for river ports. It should be observed also that the falling off in down-stream traffic is also partly due to change in economic conditions, *e.g.*, a considerable decrease in timber floating and in coal exports from Bohemia. Only in 1926 (British coal strike) did the figure for coal exports from Czechoslovakia approach the pre-war figure. In order to meet railway competition the shipping companies formed a combine, which for the greater part of the time only applied to down-stream traffic. The results have been fairly satisfactory, and although the railways captured part of the heavy goods traffic from the waterway the latter were able to secure the transport of certain classes of valuable goods.

Czechoslovakia has a considerable interest in Elbe navigation. For 1926: Out of a total of 6,385 vessels crossing the German Czechoslovak frontier (both directions together) 1,804 sailed under the Czechoslovakian flag. Of all the vessels entering and leaving the ports of Dresden and Riesa 10% or over were Czechoslovakian and the proportion of the Czechoslovak flag in the movements of vessels entering or leaving the ports of Hamburg, Harburg and Altona from or to up-stream was over 5%. For the same year the total exports of Czechoslovakia via the Elbe amounted to 1,529,000 tons (550,000 tons of sugar); in addition 112,000 tons of timber were floated. Its total imports via the Elbe for the same period amounted to 556,000 tons.

The total quantity of goods transported on the international river system exceeded 10,400,000 tons, which constitutes an increase of 2,280,000 tons over the 1925 figures, or 28%. The intercourse between the Elbe and the principal waterways connected with it was, for the Saale 369,000 tons, for the Havel about 3 million tons, for the Trave Canal 1,226,000 tons. Generally speaking river navigation begins and ends in the ports of Hamburg, Harburg and Altona. (For figures giving the despatches and arrivals of goods *see* below).

Ports.—In Czechoslovakia: *Holesovic.*—Total movement of goods 1926, 158,000 tons, principally traffic in downstream direction. *Melnik.* 255,000 tons, mainly downstream. *Usti.* 860,000 tons, increase of 66% over 1925 (British Coal Strike). The transhipment traffic before the war was over 2 million tons. It fell to ½ million tons after the war, but is now again increasing. *Loubí-Decín,* 282,000 tons (138,000 less than 1925). These ports used to be very important transhipment places, but have lost a good deal of traffic.

In Germany: *Dresden.*—Besides the important König Albert Harbour, there are old and new town quays, and the Prieschner Harbour traffic amounted to 574,000 tons in 1926, showing an increase of almost 100,000 tons over the preceding year. *Riesa* is an important place for transhipment from water to rail, and vice versa. In 1926, traffic in downstream direction amounted to 230,000 tons, in upstream direction to 423,000 tons. *Dessau Wallwitz,* total traffic 318,000 tons *Aken* total traffic 358 000 tons *S hon*-

ton For he last two ports traffic n ounts to 89% of the to a traffic *Magde* Elbe po t af.e. Hamburg, for 1926 total tons, total despatches, 575,000 tons. The *rg, Harburg and Altona* show a total of 5,050,000 in 1926 (3,382,000 in 1925); pstream direction for the same period. The port complex of Hamburg is, of ctant as a *maritime port*. In 1913, over tonnage of 14·2 million reg. tons, visited mports amounted to 16·6 million tons; as net. After the war there was a very affic. In 1919, for instance, only 2,800 tons) called at the Port. Imports and ched a figure of 2·3 million tons. From show a constant and important increase 23, the total net tonnage of 1913 is sur-tons). Imports and exports for the same ion tons. The figures for the years 1926

Net tonnage	Imports of goods	Exports of goods
Million reg. t.	Million tons	Million tons
17·4	10·7	10·6
19·6	16·8	8 3

he goods traffic reached the pre-war fig-The movement of vessels shows an in-r and 5·4 million reg. tons. The propor-rman flag is now 41·5% (1913: 60%). y, the present development is far from with pre-war times, but the increased the interest of commerce, since the num-ures of vessels has become much greater. ne.—Under Article 331 of the Treaty of its confluence with the Vltava (Moldau) l. The administration of its system was onal Commission composed of four rep-nan Riparian States, two of Czechoslo-reat Britain, France, Italy and Belgium. p the Navigation Act signed at Dresden, *eague of Nations Treaty Series*, volume The Commission has to provide for free-equality of treatment; to take decisions it of the application of the Act; to see rway is kept in good condition and to Its jurisdiction may be extended, subject t of the Commission, by decision of the oncerned. A Supplementary Convention ry 27th, 1923, laid down detailed regu-bunals and for appeal. The headquarters t Dresden. It holds one or two sessions

f the old German Empire no fewer than evied between Melnik and Hamburg, to l dues and privileged exactions of various *ical authorities*. By the Elbe Navigation between the various riparian States, a at fixed rates was substituted for the uch had been exacted previously. Still led in 1844 and 1850, and in 1863 the educed to one, levied at Wittenberg. 00 thalers were paid to Mecklenburg and which thereupon abandoned all claims to shipping, and thus navigation on the river ree.

Reich in 1911 introduced taxes on navi-ways with the exception, however, of the hich taxes had been abolished by interna-g the World War Germany established a general ta on transpo Vers hr s ier, which was also levied on goods transported on the Rhine and the Elbe. Owing to pro tests, however, of foreign Governments concerned this tax was abolished for Rhine and Elbe transport. The new Navigation Act provides that the International Commission may exceptionally and under certain conditions authorise the levying of taxes in order to cover the cost of important works of improvement. The taxes should, however, not be higher than the service rendered.

Fish.—The river is well stocked with fish, both salt-water and fresh-water species. Of the many varieties the kinds of greatest economic value are *sturgeon*, shad, salmon, lampreys, eels, pike and whiting.

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ELBERFELD, a manufacturing town of Germany, in the Prussian Rhine province, on both sides of the deep valley of the Wupper, and immediately west of and contiguous to Barmen (*q.v.*). Pop. (1925) 167,025. Local intercommunication is provided by an electric tramway line and a hanging railway—on the Langen mono-rail system—over the bed of the river. In the centre are a number of irregular and narrow streets, but many insanitary dwellings have been replaced by fine blocks. The schools include the Gymnasium (founded in 1592 by the Protestant community as a Latin school), an industrial drawing school and a commercial school. There are also a theatre, an institute of music, a museum, a zoological garden. The majority of the inhabitants are Protestant, with a strong tendency towards Pietism; but the Roman Catholics form about one-fourth of the total population. Elberfeld is the chief centre in Germany of textile manufactures and haberdashery of all descriptions, of dyes, and of fine chemicals. Leather and rubber goods, machinery, wall-paper, and stained glass are also among its staple products. On the south side of the valley is the main line from Aix-la-Chapelle, Cologne and Düsseldorf to central Germany and Berlin, on the north are many railway connections with the Ruhr Valley.

The 12th century castle of the lords of Elberfeld, feudatories of the archbishops of Cologne, passed later to the counts of Berg. A colony of bleachers, attracted by the clear waters of the Wupper, were granted in 1532 the exclusive privilege of bleaching yarn. It was not, however, until 1610 that Elberfeld was raised to the status of a town, and in 1640 was surrounded with walls. In 1760 the manufacture of silk was introduced, and dyeing with Turkey-red in 1780; but it was not till the end of the century that its industries developed into importance under the influence of Napoleon's continental system, which barred out British competition. In 1815 Elberfeld was assigned by the congress of Vienna, with the grand duchy of Berg, to Prussia, and its prosperity rapidly developed under the Prussian Zollverein.

ELBERFELD POOR RELIEF SYSTEM. This system was first identified with the town of Elberfeld in Rhenish Prussia, but has since been introduced into many of the large German towns and called after the place of its origin. The essence of the system is that it seeks to prevent pauperism and not merely to relieve the poverty of the moment. It is not purely charitable; it is also disciplinary and educational. In fact, amongst the duties that are imposed upon the Elberfeld administrators are "investigation into the conditions of the poorer classes of the population and the causes of their poverty and the adoption of effectual

preventive and remedial measures, or the recommendation of these to the municipal administrative authority."

The Elberfeld system dates back more than 100 years, although it was only placed upon its present footing in 1853. The relief of the poor in Elberfeld up to the end of the 18th century rested in the hands of the Churches, which administered voluntary contributions and donations. This charity was so freely distributed that mendicants became a danger to public morality and order. The labouring class found it comparatively easy to live by doles rather than work. Even high wages were not a sufficient inducement to prevent able-bodied men from living a life of idleness. By 1800 sufficient experience had been gained to enable an orderly system of poor relief to be set up. This consisted in a committee or board of six citizens and the principles adopted for the guidance of this board were:—

(1) Only really destitute people should be relieved.

(2) Such destitute people should be visited frequently.

(3) Relief should not exceed the necessaries of life.

(4) Every recipient of relief should be obliged to do work suited to his capacity in return for the help given.

The Elberfeld system was modified from time to time owing to the great increase in the size of the town and the necessity of centralizing relief in public hands. The main principles however have not changed. The system followed is due in the main to three men—Daniel von der Heydt, David Peters and Gustav Schlieper. In 1852 the burden of poor relief had become almost intolerable following on severe industrial and commercial depression. The plan was devised of dividing work and responsibility so far as possible. Herr von der Heydt organized the poor relief of the town in such a way that for every four recipients of assistance there was an almoner whose duty it was not only to keep the central authority acquainted with the circumstances of the poor under his charge, but also to help by personal influence and advice those in distress. It is this in the main which is the distinguishing feature of the Elberfeld System and experience has shown that the method has succeeded where the British poor law has failed. Berlin, Cologne, Crefeld, Dresden, Stuttgart and many other towns have adopted the same system, with such modifications as local circumstances have rendered necessary. The Elberfeld System recognizes two kinds of poverty, the one due to incapacity and the other to unemployment. The first kind of paupers have an unconditional claim to relief providing that those who are responsible, such as relatives, cannot supply their needs. The second may and must if possible be given work suited to their powers. The "Instruction" is interesting. "The needy but capable person, if he, or another on his behalf, applies for aid, and if he can prove that he has honestly but in vain endeavoured to obtain work and support himself, may be temporarily supported until he can earn a sufficient income, in so far as others are not liable and able to maintain him, or voluntary charity does not supply his needs; but he is bound to do such work, suited to his capacity, as may be allotted to him."

Citizen Almoners Compelled to Serve.—The relief itself is of two kinds, out-door relief (*Offene*) and closed relief (*Geschlossene*) which means maintenance in public institutions for the poor. Outdoor relief is given in money, food, clothing, furniture, medical assistance or tools. The general work of administration is in the hands of a body of nine men appointed by the municipal council and consisting of the mayor for the time being, four members of the council and four private citizens chosen by the Council, each for a period of three years. The town is divided into 39 districts (*Bezirke*) and these districts are again subdivided into 14 circuits (*Kreise*) each district has a superintendent (*Bezirksvorsteher*) and there is an almoner (*Armenpflege*) for each circuit, making 546 almoners in all.

Service in this department of public work is obligatory on every duly qualified citizen who may be nominated to it and in the event of illness the almoner is required to provide an efficient substitute. The money needed for relief is paid to the district superintendents at the periodic sittings of the Poor Administration and they allot it as required. On the other hand, food, clothing and such as are are procured from the Poor House. No orders are given on the local tradesmen. Each almoner has charge of a certain number of houses and is responsible for the care of the poor in those houses. Since the number in his care is strictly limited, he is able to make the personal acquaintance of each applicant for relief and to investigate the conditions under which they live. As a rule an almoner must not have more than four cases to look after at any one time and he must visit them in their own homes at least once a fortnight.

The Elberfeld system differs from the poor law administration in England in one important respect; indoor relief is not adopted as a test of destitution. It is true that this is no longer in every case the actual practice in England, but the theory remains the same. In any case under the Elberfeld system relief is only given where the applicant's earnings fail to provide the absolute necessaries of life, and in order to determine when this point has been reached a "standard of income" has been laid down which of course varies from time to time and has been changed since the World War. Tested by its results, it must be conceded that the Elberfeld system has been a success, and although the War caused its break-down, in normal times it reduces mendicancy to a minimum, diminishes pauperism, and encourages provident habits and a desire for honourable employment. (P. A.)

ELBERTON, a city of north-eastern Georgia, U.S.A., 100 m. from the Savannah river; the county seat of Elbert county. It is served by the Elberton and Eastern, the Seaboard Air Line, and the Southern railways. The population was 6,475 in 1920 (37% negroes). The region produces especially cotton, grain, clovers, alfalfa and peaches. There are many granite quarries in the vicinity, and the city manufactures cotton drills and denims, cotton-seed oil and artificial silk. It was founded about 1790.

ELBEUF, a town of northern France in the department of Seine-Inférieure, 14 m. S.S.W. of Rouen by the Ouest-État railway. Pop. (1926) 17,325. Elbeuf, a town of wide, clean streets with handsome houses and factories, stands on the left bank of the Seine at the foot of hills over which extends the forest of Elbeuf. Elbeuf was, in the 13th century, the centre of an important fief held by the house of Harcourt, but its previous history goes back at least to the early years of the Norman occupation, when it appears under the name of Hollebof. It passed into the hands of the houses of Rieux and Lorraine, and was raised to the rank of a duchy in the peerage of France by Henry III. in favour of Charles of Lorraine (d. 1605), grandson of Claude, duke of Guise, master of the hounds and master of the horse of France. The last duke of Elbeuf was Charles Eugène of Lorraine, prince de Lambesc, who died in 1825. The churches of St. Étienne and St. Jean, both Renaissance with later additions, preserve 16th century stained glass. A tribunal and chamber of commerce, a board of trade-arbitrators, a school of industry and a school of cloth manufacture are among its institutions. The town with its suburbs, Orival (pop. 1,019) Caudebec-lès-Elbeuf (8,856), St. Aubin (3,971) and St. Pierre (3,029), is one of the principal and most ancient seats of the woollen manufacture in France. As a river-port it has a brisk trade in the produce of the surrounding district as well as in the raw materials of its manufactures, especially in wool from La Plata, Australia and Germany.

ELBING, a seaport town of Germany, in the Province of East Prussia, on the Elbing, 5 m. above the Frische Haff. Pop. (1925) 67,762. Elbing originated as a colony of traders, from Lübeck and Bremen, which established itself under protection of a castle of the Teutonic Knights, built in 1237. In 1246 the town acquired "Lübeck rights," *i.e.*, the full autonomy conceded by the charter of the emperor Frederick II. in 1226 (*see* LÜBECK), and it was early admitted to the Hanseatic League. In 1454 the town repudiated the overlordship of the Teutonic Order, and placed itself under the protection of the king of Poland, becoming the seat of a Polish voivode. From 1560 to 1626 it was the seat of the English Eastland Company, and the sole emporium for English goods on the Baltic. Later its decline was hastened by the wars of the early 18th century. In 1772, when it fell to Prussia through the first partition of Poland, it was utterly decayed. The

town is connected by canals to the Vistula and to lakes Geserich and Drewenz. The old town was formerly surrounded by fortifications, but of these only a few fragments remain. The Marienkirche dates from the 15th century and is as restored in 1887. The classical school was founded in 1536 The town-hall (1894) contains a historical museum

The great Schichau iron-works in Elbing make locomotives and machinery. In addition to this there are important iron foundries, and manufactories of cigars, lacquer and metal ware, ploughs, sugar, organs, etc. There is a considerable trade also in agricultural produce.

ELBOW, in anatomy, the articulation of the *humerus*, the bone of the upper arm, and the *ulna* and *radius*, the bones of the forearm (*see* JOINTS). The word is thus applied to things which are like this joint in shape, such as a sharp bend of a stream or river, an angle in a tube, etc.

ELBURZ, more correctly **ELBRUZ,** a chain of mountains, separating the Caspian depression from the Persian highlands, and extending without any break for 650 m. from the western shore of the Caspian Sea to north-eastern Khurasan. According to the direction, or strike, of its principal ranges the Elburz may be divided into three sections: the first 120 m. in length with a direction nearly N. to S., the second 240 m. in length with a direction N.W. to S.E., and the third 290 m. in length striking S.W. to N.E. The first section, which is connected with the system of the Caucasus, and begins west of Lenkoran in 39° N. and 49° E., is known as the Talish range and has several peaks 9,000 to 10,000 ft in height. It runs almost parallel to the western shore of the Caspian, and west of Astara is only 10 or 12 m. distant from the sea At the point west of Resht, where the direction of the principal range changes to one of N.W. to S.E., the second section of the Elburz begins, and extends from there to beyond Mount Damavand, east of Tehran. South of Resht this section is broken through at almost a right angle by the Safid Rud (White river), and along it runs the motor road between the Caspian and inner Persia, Resht-Kazvin-Tehran. The Elburz then splits into three principal ranges running parallel to one another and connected at many places by secondary ranges and spurs. Many peaks of the ranges in this section have an altitude of 11,000 to 13,000 ft., and the elevation of the passes leading over the ranges varies between 7 000 and 10,000 ft. The highest peaks are situated in the district of Talikan, N.W. of Tehran, and thence eastwards to beyond Mount Damavand. The part of the Elburz immediately north of Teheran is known as the Kuh i Shamran (from the name of the Shamran district on its southern slopes) and culminates in the Sar i Tuchal (12,600 ft.). Beyond it, and between the border of Talikan in the N.W. and Mount Damavand in the N.E., are ranges with elevations of 12,000 to 13,500 ft, while Damavand towers above them all with its altitude of 18.600 ft. The eastern foot of Damavand is washed by the river Harhaz, which there breaks through the Elburz in a S.-N. direction in its course to the Caspian, past the town of Amul. The third section of the Elburz, with its principal ranges striking S.W. to N.E., has a length of about 290 m., and ends some distance beyond Bujnurd in northern Khurasan, where it joins the Ala Dagh range, which has a direction to the S.E., and, continuing with various appellations to northern Afghanistan, unites with the Paropamisus range. This section of three principal ranges has many peaks over 10,000 ft in height, and the Nizva mountain on the southern border of the unexplored district of Hazar Jarib, north of Samnan, and the Shah Kuh, between Shahrud and Astarabad, have an elevation exceeding 13,000 ft. Beyond Khush Yailaq, with an elevation of 10 000 ft., are the Kuh i Buhar (8,000) and Kuh i Suluk (8,000), which latter joins the Ala Dagh (11,000).

The northern slopes of the Elburz and the lowlands which lie between them and the Caspian, and together form the provinces of Gilan, Mazandaran and Astarabad, are covered with dense forest and traversed by hundreds of perennial rivers and streams. The breadth of the lowlands between the foot of the hills and the sea is from 2 to 25 m., the greatest breadth being in the meridian of Resht in Gilan, and in the districts of Amul, Sari and Barfurush in Mazandaran The inner slopes and ranges of the Elburz south of the principal watershed, generally the central one of the three principal ranges which are outside of the fertilizing influence of the moisture brought from the sea, have little or no natural vegetation, and those farthest south are, excepting for a few stunted cypresses, completely arid and bare.

The higher ranges of the Elburz are snow-capped for the greater part of the year, and some, which are not exposed to the refracted heat from the arid districts of inner Persia, are rarely without snow. Water is plentiful, and situated in well-watered valleys and gorges are innumerable flourishing villages, with extensive cultivated fields, orchards and pastures, and at higher altitudes small plateaus, under snow until March or April, afford cool camping grounds to the nomads of the plains, and luxuriant grazing to their sheep and cattle during the summer. The Elburz mountains are said to abound in mineral wealth, particularly coal, lead and iron

See L. S. Fortescue, "The Western Elburz and Persian Azerbaijan" *Geog. Jour.*, vol lxiii., pp 301–318 (London, 1924).

EL CANO, JUAN SEBASTIAN DEL (d. 1526), Spanish navigator, was born in Guetaria. He commanded one of the five vessels in the famous expedition of Magellan, and in 1521, on Magellan's death, became chief. He visited the Moluccas and returned to Spain on Sept. 8, 1522, having been the first to circumnavigate the globe. He died on the expedition to Loaisa which had set sail on July 25, 1525.

See F. Navarette, *Coleccion de documentos inedítos*, t. i. (1842) O. Koelliker, *Die Erste Erdumseglung etc.* (Munich, 1908); A. M Alvarez, *Juan Sebastian del Cano* (1923).

EL CENTRO, a city of southern California, U.S.A., 10m from the Mexican border; the county seat of Imperial county It is on Federal highway 80, at the southern terminus of number 99, and is served by the Southern Pacific railway. The population in 1920 was 5,464, and was estimated locally at over 11,000 in 1928. The city lies 51ft. below sea-level, in the midst of the Imperial valley, which has been transformed by irrigation from a barren desert into extraordinarily fertile farmland. Alfalfa cantaloupes, lettuce, grape-fruit, asparagus and dates are among the distinctive products. Stock-raising and dairying also are important industries, and there are creameries in the city. The growing season extends through the entire year, and some crop is harvested every month. There is a petrified forest near Dixieland 20m. W., and Painted Canyon is 23m. W. by north. El Centro was settled in 1906, and was incorporated as a city in 1907.

ELCHE, town in eastern Spain, province of Alicante, on the river Vinalapo and the Murcia–Alicante railway. Pop. (1920) 33,167. Elche contains no building of high architectural merit, except, perhaps, the collegiate church of Santa Maria, with its lofty blue-tiled dome and fine portico. Its narrow streets and flat-roofed, whitewashed houses, however, and, above all, the innumerable date-palms, give the city, standing on a low hill in the midst of a sandy plain, a strikingly oriental aspect. Date cultivation in the country is almost limited to this locality, where it is the chief occupation, and though the dates are inferior to those of the Barbary States, large quantities are exported. The blanched fronds are also sold for Palm Sunday processions, and when blessed by the priest are regarded throughout Spain as certain defences against lightning. Other products are pomegranates, figs, olives, almonds and cereals, and Elche manufactures oil, soap flour, esparto fabrics and many leather and rope-soled shoes for export. The harbour is Santa Pola (pop. 4,022), 6 m. E.S.E., where the Vinalapo enters the Mediterranean.

Elche, probably the Iberian *Helike* and the Roman *Ilici* or *Illici*, was held from the 8th to the 13th century by the Moors, who gave it the irrigation system on which its wealth depends. In 1332 it was finally captured by the Spaniards.

ELCHINGEN, a village of Germany, in Bavaria, not far from the Danube, 5m N.E. from Ulm. Here, on Oct. 14, 1805 the Austrians under Riesch were defeated by the French under Ney, who by taking the bridge decided the day and gained for himself the title of duke of Elchingen. (*See* NAPOLEONIC CAMPAIGNS)

ELDAD BEN MAHLI, also surnamed HAD-DANI, or the Danite Jewish traveller was the supposed author of a Jewish

[illegible] 9th century A.D. The story, which is highly fictitious, describes how Eldad set out to visit the Jews in Africa and Asia, and fell into the hands of cannibals. Saved by his leanness, he was captured by another tribe, with whom he spent four years before being ransomed by a Jewish merchant. He then describes his visits to the dwelling-places of the lost tribes. Issachar he found in the mountains of Media. Zabulon and Reuben near the Paran mountains. Ephraim and half Manasseh near Mecca, and Simeon and the other half of Manasseh in Chorazin. Dan, Naphtali, Asher and Gad had founded an independent kingdom in the gold land of Havila beyond Abyssinia, whither also Levi had come from near Babylon.

The real Eldad, to whom this work is ascribed, was a celebrated Jewish traveller and philologist, fl. *c.* 830–890. Born in Arabia, Palestine, or Media, he travelled in Mesopotamia, northern Africa, and Spain, spent several years in Tunis, and died at Córdova.

Epstein and D. A. Müller suggest a relationship between the letter of Prester John and the narrative of Eldad, but the affinity is not close. Eldad is quoted as an authority on linguistic points by the leading Jewish philologists of the time.

BIBLIOGRAPHY.—The work ascribed to Eldad is in Hebrew, divided into six chapters, probably abbreviated from the original text. The first edition appeared at Mantua about 1480; the second at Constantinople in 1516; this was reprinted at Venice in 1544 and 1605, and at Jessnitz in 1722. A Latin version by Gilb. Génébrard was published at Paris in 1563, under the title of *Eldad Danius . . . de Judaeis clausis eorumque in Aethiopia . . . imperio*, and was afterwards incorporated in the translator's *Chronologia Hebraeorum* of 1584; a German version appeared at Prague in 1695, and another at Jessnitz in 1723. In 1838 E. Carmoly edited and translated a fuller recension which he had found in a ms. from the library of Eliezer Ben Hasan, forwarded to him by David Zabach of Morocco (see *Relation d'Eldad le Danite*, Paris, 1838). Both forms are printed by Dr. Jellinek in his *Bet-ha-Midrasch*, vols. ii. p. 102, etc., and iii. p. 6, etc. (Leipzig, 1853–55). See also Bartolocci, *Bibliotheca magna Rabbinica*, i. 101–130; Fürst, *Bibliotheca Judaica*, i. 30, etc.; Hirsch Grsetz, *Geschichte der Juden* (3rd ed., Leipzig, 1895), v. 239–244; Rossi, *Dizionario degli Ebrei*; Steinschneider, *Cat. librorum Hebraeorum in bibliotheca Bodleiana*, cols. 923–925; Kitto's *Biblical Cyclopaedia* (3rd ed., *sub nomine*); Abr. Epstein, *Eldad ha-Dani* (Presburg, 1891); D. H. Müller, "Die Recensionen und Versionen des Eldad-Had-dani," in *Denkschriften d. Wiener Akad.* (Phil.-Hist. Cl.), vol. xli. (1892), pp. 1–80; C. C. Rossini, "Leggende geografiche guidaiche del IX. secolo (il Sefer Eldad)," *Reale soc. geografica italiana*, Serie 6, vol. ii., pp. 160–190 (Roma, 1925).

ELDER, the name given at different times to a ruler or officer in certain political and ecclesiastical systems of government.

1. The office of elder is in its origin political and is a relic of the old patriarchal system. The unit of primitive society is always the family; the only tie that binds men together is that of kinship. With the development of civilization there came a time when age ceased to be an indispensable condition of leadership. The old title was, however, generally retained, *e.g.*, the γέροντες so often mentioned in Homer, the γερουσία of the Dorian states, the *senatus* and the *patres conscripti* of Rome, the sheikh or elder of Arabia, the alderman of an English borough, the *seigneur* (Lat. *senior*) of feudal France.

2. It was through the influence of Judaism that the originally political office of elder passed over into the Christian Church and became ecclesiastical. The Israelites inherited the office from their Semitic ancestors (just as did the Moabites and the Midianites, of whose elders we read in Numbers xxii. 7), and traces of it are found throughout their history. During the sojourn in the wilderness the elders were the intermediaries between Moses and the people, and it was out of the ranks of these elders that Moses chose a council of seventy "to bear with him the burden of the people" (Numbers xi. 16). The elders were the governors of the people and the administrators of justice. The powers of the elders were gradually curtailed by the development of the monarchy, by the appointment of special judges and the use of the priestly orders.

3. The name "elder" was probably the first title bestowed upon the officers of the Christian Church—since the word deacon does not occur in connexion with the appointment of the Seven in Acts vi. Its universal adoption is due not only to its currency amongst the Jews, but also to the fact that it was frequently used as the title of magistrates in the cities and villages of Asia Minor. For the history of the office of elder tion between elders and bishops

4. In modern times the use o fined to the Presbyterian church called elders. According to the government, there are two clas or those specially set apart to elders," who are laymen, chose and set apart by ordination t in the oversight and governmen

See W. R. Smith, *History of the* E. Schürer, *The Jewish People in History of Israel and Judah*; G. and *see* PRESBYTERIANISM.

ELDER, the popular design trees constituting the genus S foliaceae. The common elder, *S* Africa, western Asia, the Ca sheltered spots it attains a he smooth: the shoots are stout anc pinnate, with oval or elliptical l dense flat-topped clusters (cor branches, have a cream-coloured five stamens and three sessile s black, globular and three- or fou ber. The elder thrives best in n can be grown in a great diversit making screen-fences in bleak. a shelter for other shrubs in the ping two or three times a year, i in growth. The young trees fu much pith; the wood of old grained, polishes well, and is combs, skewers, mathematical Young elder twigs deprived of p

BY COURTESY OF THE ROYAL HORTICULTURAL SOCIETY

BRANCHES OF THE COMMON ELDER (SAMBUCUS NIGER) SHOWING (A) INFLORESCENCE AND (B) BERRIES, FROM WHICH WINE IS MADE

lieved to be repugnant to insect the hat must be doffed in the p certain of the English midland c that the cross of Christ was mad a common mediaeval tradition which Judas hanged himself. It by the superstitious to be und mother": its flowers may not b wood must not be employed f a child sleeping in an elder

entangled by the Elder mother

The scarlet berried elder (*S. racemosa*) is the handsomest species of the genus. It is a native of various parts of Europe, Asia and North America, growing in Britain to a height of over 15 ft., but often producing no fruit. The dwarf elder or danewort (supposed to have been introduced into Britain by the Danes), *S. Ebulus*, a common European species, reaches a height of about 6 ft. Its cyme is hairy, has three principal branches, and is smaller than that of *S. nigra;* the flowers are white tipped with pink.

Besides the red-berried elder, found in rocky soil from Newfoundland to Alaska and southward to Georgia and California, several other species are native to North America. The best known of these is the American or sweet elder (*S. canadensis*), common in moist soil from Nova Scotia to Manitoba and south to Florida, Texas and the West Indies, with deep-purple or black edible fruit. The blue elder (*S. glauca* or *S. caerulea*), found from British Columbia to Montana south to Lower California and New Mexico, usually a thicket bush 6 ft. to 10 ft. but sometimes a tree 25 ft. high, bears blue fruit covered with a white bloom.

ELDON, JOHN SCOTT, 1ST EARL OF (1751–1838), Lord High Chancellor of England, was born at Newcastle on June 4, 1751. His father was a coal-broker in Newcastle who had made a fortune. He was educated at Newcastle Grammar school, and was to have been apprenticed to his father's business, but his brother William (afterwards Lord Stowell) interfered to send him to University college, Oxford, where he won the English Essay prize, and graduated in 1770 and took a fellowship. He destroyed his chances of a college living by eloping with Bessy, daughter of Aubone Surtees, of Newcastle. His father was subsequently reconciled to them, as was Mr. Surtees. He entered the Middle Temple in Jan. 1773, and was called to the bar in 1776, practising in London and on the Northern Circuit. He was helped on by his brother, now Camden Professor of Ancient History, and by Andrew Bowes, who retained him as junior in his election petition for Newcastle. In 1780 he made his name in *Ackroyd* v. *Smithson*, still a leading case, which he insisted on taking up on appeal in opposition to his clients' opinion, and won before Lord Thurlow. The next year he enhanced his reputation in the Clitheroe election petition. In 1782 he took silk, and soon had a huge practice on the Northern Circuit, at the Parliamentary Bar, and in Chancery.

In 1782 he went into Parliament for Lord Weymouth's close borough of Weobley, as a supporter of Pitt. His first speeches were made against Fox's India bill, and were very thoroughly ridiculed by Sheridan. In 1788 he was made Solicitor-General and knighted, and the next year he is said to have drafted the Regency bill. In 1793 he became Attorney-General, and conducted the prosecutions against the supporters of the French Revolution, especially that against Horne Tooke. In 1799 he became Chief Justice of the Common Pleas, with the title of Baron Eldon, and in 1799 he was Lord Chancellor in Addington's ministry, which he owed to his anti-Catholic zeal. In 1804 we find him conducting the negotiations that led to Pitt succeeding Addington, and he remained Lord Chancellor under Pitt. Pitt's death was followed by Grenville's ministry, and then under Liverpool, Eldon returned to the Woolsack, where he continued the predominant member of the Cabinet for 20 years. He was made an earl in 1821. In 1827 Canning, a supporter of Catholic Emancipation, became Prime Minister, and he resigned; he fully hoped to be asked to take office again under Wellington, but was disappointed. His wife, to whom he was entirely devoted, died in 1831, and Eldon died in London on Jan. 13, 1838.

As a legislator he was profoundly conservative. For 40 years he fought innovation by repression, seeing in every reform proposed the downfall of the country, and preserving himself and his party in power by tact, conservatism and anti-Catholicism. As a judge, his greatness is indisputable, though his judgments, as voluminous as they are profound, are notably clumsy in form. During the many years he presided over the Chancery he naturally had a considerable effect on the development of Equity. Most of this is purely technical, but it should be observed that it was under his influence that the injunction became so important a weapon in the Chancellor's armoury, and the rules for its use be are set ed. But he had one fatal fault, his slowness, which outweighed all his virtues. The notorious slowness of the Chancery reached its climax under him, and it is said that he would keep papers by him for years, though he rarely altered his first estimate of a case. It is the procedure under him that is satirized in the famous verse that ends, "And the Chancellor said—'I doubt'."

BIBLIOGRAPHY.—Horace Twiss, *Life of Lord Chancellor Eldon* (1844); W. E. Surtees, *Sketch of the Lives of Lords Stowell and Eldon* (1846); Lord Campbell, *Lives of the Chancellors;* W. C. Townsend *Lives of Twelve Eminent Judges* (1846); *Greville Memoirs.*

EL DORADO (Span. "the gilded one") a name applied first to the king or chief priest of a South American tribe, who was said to cover himself with gold dust, at a yearly religious festival held near Santa Fé de Bogotá; next, to a legendary city called Manoa or Omoa; and lastly to a mythical country in which gold and precious stones were found in fabulous abundance. The legend had many variants, especially as regards the situation attributed to Manoa. It induced many Spanish explorers to lead expeditions in search of treasure, but all failed. Among the most famous were the expedition undertaken by Diego de Ordaz, whose lieutenant Martínez claimed to have been rescued from shipwreck, conveyed inland, and entertained at Omoa by "El Dorado" himself (1531); the journeys of Orellana (1540–41), who passed down the Rio Napo to the valley of the Amazon; that of Philip von Hutten (1541–45) who led an exploring party from Coro on the coast of Caracas; and of Gonzalo Ximenes de Quesada (1569), who started from Santa Fé de Bogotá.

Sir Walter Raleigh, who resumed the search in 1595, described Manoa as a city on Lake Parimá in Guiana. This lake was marked on English and other maps until its existence was disproved by A. von Humboldt (1769–1859). Meanwhile, the name of El Dorado came to be used metaphorically of any place where wealth could be rapidly acquired. It was given to a county in California, and to towns and cities in various states. In literature frequent allusion is made to the legend, perhaps the best-known references being those in Milton's *Paradise Lost* (vi. 411) and Voltaire's *Candide*, (ch. 18, 19).

See A. F. A. Bandelier, *The Gilded Man, El Dorado* (1893).

EL DORADO, a city of southern Arkansas, U.S.A., 15m. from the Louisiana boundary; the county seat of Union county. It is on Federal highway 167, and is served by the El Dorado and Wesson, the Missouri Pacific and the Rock Island railways. The population was 3,887 in 1920 (26% negroes) and was estimated locally at 30,000 in 1928. It is the metropolis of the pioneer oil-field of the State, which in 1928 was producing about 85,000bbl. daily. In 1921 the discovery well was brought in. El Dorado was settled in 1843 and incorporated in 1870.

ELDORADO, a city of Saline county, Ill., U.S.A., in the south-eastern part of the State, on Federal highway 45, and served by the Big Four, the Illinois Central and the Louisville and Nashville railways. The population was 5,004 in 1920 (95% native white). It is the trade centre and shipping point for a coal-mining and farming region, and has some manufacturing industries.

ELDORADO, a city in the oil-fields of south-eastern Kansas, U.S.A., 31m. N.E. of Wichita; the county seat of Butler county. It is on Federal highways 54 and 77, and is served by the Missouri Pacific and the Santa Fe Railways. The population was 3,129 in 1910; 10,995 in 1920 (95% native white); and 9,500 in 1925 (State census). It is the shipping and supply centre for a farming, stock-raising and oil-producing region.

ELDUAYEN, JOSÉ DE, 1st Marquis del Pazo de la Merced (1823–1898), Spanish politician, was born in Madrid on June 22, 1823. He was educated in the capital, took the degree of civil engineer, and directed important works in Asturias and Galicia, entered the Cortes in 1856 as deputy for Vigo, and sat in all the parliaments until 1867 as member of the Union Liberal with Marshal O'Donnell. He attacked the Miraflores cabinet in 1864, and became under-secretary of the home office when Canovas was minister in 1865. He was made a councillor of State in 1866, and in 1868 assisted the other members of the Union Liberal in preparing the revolution. He accepted office as member of the

last Zagasta cabinet under King Amadeus. On the proclamation of the republic Elduayen co-operated in the Alphonsist conspiracy, and endeavoured to induce the military and politicians to work together. He went abroad to meet and accompany the prince after the *pronunciamiento* of Marshal Campos landed with him at Valencia, was made governor of Madrid, a marquis, grand cross of Charles III., and minister for the colonies in 1875. He accepted the portfolio of foreign affairs in the Canovas cabinet from 1883 to 1885, and was made a life senator. He died at Madrid on June 24, 1898.

ELEANOR OF AQUITAINE (*c.* 1122–1204), wife of the English king Henry II., was the daughter and heiress of Duke William X. of Aquitaine, whom she succeeded in April 1137. She married Prince Louis the heir to the French crown, and a month later her husband became king of France under the title of Louis VII. Eleanor bore Louis two daughters but no sons. Their marriage was annulled by mutual consent in 1151. She then married Henry of Anjou. Louis, who had hoped that Aquitaine would descend to his daughters, was mortified and alarmed by the Angevin marriage; all the more so when Henry of Anjou succeeded to the English crown in 1154. From this event dates the beginning of the secular strife between England and France which runs like a red thread through mediaeval history.

Eleanor bore to her second husband five sons and three daughters: John, the youngest of their children, was born in 1167. But her relations with Henry passed gradually through indifference to hatred. Henry was an unfaithful husband, and Eleanor supported her sons in their great rebellion of 1173. Throughout the latter years of the reign she was kept in a sort of honourable confinement. It was during her captivity that Henry formed his connection with Rosamond Clifford, the Fair Rosamond of romance. Eleanor, therefore, can hardly have been responsible for the death of this rival, and the romance of the poisoned bowl appears to be an invention of the next century.

Under the rule of Richard and John the queen became a political personage of the highest importance. To both her sons the popularity which she enjoyed in Aquitaine was most valuable. She helped to frustrate the conspiracy with France which John concocted during Richard's captivity. She afterwards reconciled the king and the prince, thus saving for John the succession which he had forfeited by his misconduct. In 1199 she crushed an Angevin rising in favour of John's nephew, Arthur of Brittany. In 1201 she negotiated a marriage between her grand-daughter, Blanche of Castile, and Louis of France, the grandson of her first husband. It was through her staunch defence of Mirabeau in Poitou that John got possession of his nephew's person. She died on April 1, 1204, and was buried at Fontevrault. Although a woman of strong passions and great abilities she is, historically, less important as an individual than as the heiress of Aquitaine, a part of which was, through her second marriage, united to England for some 400 years.

See the chronicles cited for the reigns of Henry II., Richard I. and John. Also Sir J. H. Ramsay, *Angevin Empire* (1903); K. Norgate, *England under the Angevin Kings* (1887); and A. Strickland, *Lives of the Queens of England*, vol. i. (1841).

ELEANOR OF CASTILE (d. 1290), daughter of Ferdinand III. of Castile by his second wife Joanna, half-sister of Alfonso X., married Edward I. in Oct. 1254, at the monastery of Las Huelgas. Through this marriage Edward succeeded to the provinces of Ponthieu and Montreuil in his wife's right, and Alfonso also gave up in his favour his claims on Gascony. After a year with her husband in Gascony, Eleanor came to England, on Oct. 17, 1255, and Edward joined her in November of the same year. In 1264, after the battle of Lewes, the earl of Leicester influenced the king to send her out of England, and she took refuge in France, returning to England on Oct. 29, 1265, after the battle of Evesham. She went with Edward in 1270 on his crusade, and on Aug. 19, 1274 they were both crowned. She caused some scandal by using the services of Jewish usurers to obtain estates from some Christians, and Archbishop Peckham was obliged to intervene on behalf of tenants on whom she laid too heavy a burden. She was in other respects a pious woman. She fell ill towards the end of 1290, and died on Nov. 28, probably at Harby, Nottinghamshire.

ELEATIC SCHOOL, a Greek school of philosophy which came into existence towards the end of the 6th century B.C., and ended with Melissus of Samos (*fl. c.* 450 B.C.). It took its name from Elea, a Greek city of lower Italy, the home of its chief exponents, Parmenides and Zeno. Its foundation is often attributed to Xenophanes of Colophon, but, although there is much in his speculations which formed part of the later Eleatic doctrine it is probably more correct to regard Parmenides as the founder of the school. At all events, it was Parmenides who gave it its fullest development. The main doctrines of the Eleatics were evolved in opposition, on the one hand, to the physical theories of the early physical philosophers who explained all existence in terms of primary matter (*see* IONIAN SCHOOL), and, on the other hand, to the theory of Heraclitus that all existence may be summed up as perpetual change. As against these theories the Eleatics maintained that the true explanation of things lies in the conception of a universal unity of being. The senses with their changing and inconsistent reports cannot cognize this unity: it is by thought alone that we can pass beyond the false appearances of sense and arrive at the knowledge of being, at the fundamental truth that "the All is One." There can be no creation, for being cannot come from not-being; a thing cannot arise from that which is different from it. The errors of common opinion arise to a great extent from the ambiguous use of the verb "to be," which may imply existence or be merely the copula connecting subject and predicate.

In these main contentions the Eleatic school achieved a real advance, and paved the way to the modern conception of metaphysics. Xenophanes in the middle of the 6th century had made the first great attack on the crude mythology of early Greece, including in his onslaught the whole anthropomorphic system enshrined in the poems of Homer and Hesiod. In the hands of Parmenides this spirit of free thought developed on metaphysical lines. Subsequently, whether from the fact that such bold speculations were obnoxious to the general sense of propriety in Elea, or from the inferiority of its leaders, the school degenerated into verbal disputes as to the possibility of motion, and similar academic trifling. The best work of the school was absorbed in the Platonic metaphysic.

See E. Caird, *Evolution of Theology in the Greek Philosophers*, 1904. *See also* the articles on XENOPHANES; PARMENIDES; ZENO (of Elea); MELISSUS, with the works there quoted; also the histories of philosophy by Zeller, Gomperz, Windelband, etc.

ELECAMPANE (*Inula Helenium*), a perennial plant, family *Compositae*, common in many parts of Britain, and ranges throughout central and southern Europe, and in Asia as far eastwards as the Himalayas. It is also widely naturalized in North America, occurring along roadsides and in fields from Nova Scotia westward to Ontario and Minnesota and southward to North Carolina and Georgia. Elecampane is a rather stout and rigid herb, the stem of which attains a height of 3 to 5 ft.; the leaves are large and toothed, the lower ones stalked, the rest embracing the stem; the flowers are yellow, 2 in. broad, and have many rays, each three-notched at the extremity. The root is thick, branching and mucilaginous, and has a warm, bitter taste and a camphoraceous odour. Besides *inulin* $(C_6H_{10}O_5)6n$, isomeric with starch, the root contains *helenin*, C_8H_8O. By the ancients the root was employed both as a medicine and as a condiment, and in England it was formerly in great repute as a tonic and stimulant of the secretory organs. As a drug, however, the root is now seldom resorted to except in veterinary practice.

ELECTION: *see* ELECTORAL SYSTEMS; REPRESENTATION.

ELECTION, in English law, the obligation imposed upon a person whose property is purported to be disposed of by an instrument which confers property on him, to choose whether he will retain his own property and compensate the person to whom it is purported to be given, or transfer his own property and take the property given him by the instrument. To put a donee of property to his election three conditions must be fulfilled: (1) The donor's gift to him must be of property the donor had free

power to dispose of. Thus a gift to a beneficiary under a special power or part of the funds subject thereto does not put the beneficiary to his election if the *donee* of the power attempts by the same instrument to give the beneficiary's own property to someone else. (ii.) The property given must be given in such a way that the beneficiary can make compensation out of it if he chooses to retain his own. Thus a gift to a married woman of property subject to a condition against alienation does not put her to an election. (iii.) The gift must not be made conditional on the donee transferring his property. Here the case is not one of election but of alternative gifts, and if the donee elects against the instrument he thereby abandons all claim to the gift.

In cases of election it must be made clear that the donor intended to dispose of the donee's property, but it is of no importance whether he knew or not at the time he executed the instrument that it was the donee's property.

Elections almost invariably arise under wills, but they may arise under deeds, as, for example, when a minor executes a marriage settlement under which she assigns her property on certain trusts and receives benefits in her husband's property. She cannot, on attaining full age, repudiate her assignment and retain the benefits conferred on her by the settlement. (*See* also ELECTORAL SYSTEMS; PARLIAMENT; REPRESENTATION; VOTE.)

ELECTORAL COMMISSION, in United States history, a commission created to settle the disputed presidential election of 1876. In this election Samuel J. Tilden, the Democratic candidate, received 184 uncontested electoral votes, and Rutherford B. Hayes, the Republican candidate, 163. The states of Florida, Louisiana, Oregon and South Carolina, with a total of 22 votes, each sent in two sets of electoral ballots, and from each of these states except Oregon one set gave the whole vote to Tilden and the other gave the whole vote to Hayes. From Oregon one set of ballots gave the three electoral votes of the state to Hayes; the other gave two votes to Hayes and one to Tilden.

The manner of selecting the electors is left to State law; the electoral ballots are sent to the president of the Senate, who "shall, in the presence of the Senate and House of Representatives, open all certificates, and the votes shall then be counted." Concerning this provision many questions of vital importance arose in 1876: Might Congress or an officer of the Senate go behind a State's certificate and review the acts of its certifying officials? Might it go further and examine into the choice of electors? And if it had such powers, might it delegate them to a commission? The fact, however, that the Senate in 1876 was controlled by the Republicans and the House by the Democrats, lessened the chances of any harmonious settlement of these questions by Congress. In consequence, the country seemed on the verge of civil war. Hence it was that by an act of Jan. 29, 1877, Congress created the Electoral Commission to pass upon the contested returns, giving it "the same powers, if any" possessed by itself in the premises, the decisions to stand unless rejected by the two houses separately.

The commission was composed of five Democratic and five Republican Congressman, two justices of the Supreme Court of either party, and a fifth justice chosen by these four. As its members of the commission the Senate chose G. F. Edmunds of Vermont, O. P. Morton of Indiana and F. T. Frelinghuysen of New Jersey (Republicans); and A. G. Thurman of Ohio and T. F. Bayard of Delaware (Democrats). The House chose Henry B. Payne of Ohio, Eppa Hunton of Virginia and Josiah G. Abbott of Massachusetts (Democrats); and George F. Hoar of Massachusetts and James A. Garfield of Ohio (Republicans). The Republican judges were William Strong and Samuel F. Miller; the Democratic, Nathan Clifford and Stephen J. Field. These four chose as the fifteenth member Justice Joseph P. Bradley, a Republican but the only member not selected avowedly as a partisan. It had been expected that the fifth member from the Supreme Court would be David Davis, an independent, but he was elected to the Senate by the Illinois legislature and declined to serve on the commission.

The popular vote seemed to indicate that Hayes had carried South Carolina and Oregon, and Tilden Florida and Louisiana. It was evident, however, that Hayes could secure the 185 votes necessary to elect only by gaining every disputed ballot. As the choice of Republican electors in Louisiana had been accomplished by the rejection of several thousand Democratic votes by a Republican returning board, the Democrats insisted that the commission should go behind the returns and correct injustice: the Republicans declared that the State's action was final, and that to go behind the returns would be invading its sovereignty. When this matter came before the commission it virtually accepted the Republican contention. By the votes of the eight Republicans to the seven Democrats, the electoral votes of Florida and Louisiana were given to Hayes. The commission unanimously awarded the South Carolina and Oregon votes to Hayes.

The strictly partisan votes of the commission and the adoption by prominent Democrats and Republicans, both within and without the commission, of an attitude toward States-rights principles quite inconsistent with party tenets and tendencies, have given rise to much severe criticism. The Democrats and the country, however, quietly accepted the decision. The judgments underlying it were two: (1) That Congress rightly claimed the power to settle such contests within the limits set; (2) that, as Justice Miller said regarding these limits, the people had never at any time intended to give to Congress the power, by naming the electors, to "decide who are to be the president and vice-president of the United States."

There is no doubt that Tilden was *morally* entitled to the presidency, and the correction of the Louisiana frauds would certainly have given satisfaction then and increasing satisfaction later, in the retrospect, to the country. The commission might probably have corrected the frauds without exceeding its Congressional precedents. Nevertheless, the principles of its decisions must be recognized by all save ultra-nationalists as truer to the spirit of the Constitution and promising more for the good of the country than would have been the principles necessary to a contrary decision.

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ELECTORAL SYSTEMS. To elect is to choose, and in the sense of the present discussion, an electoral system is a means of choice of members of a governmental organization—a term used in preference to the word state, to emphasize the concrete nature of the purpose served by an electoral system. Political theorists and practical politicians can be ranged into two great schools of thought: those who look upon systems of election absolutely as equitable expressions of the sovereignty of the people; and those who, accepting the sovereignty of the people and the representative principle, yet regard the system of election pragmatically, as an instrument of government in which absolute equity must not seldom retreat before the pressing need for government. On every occasion of the modification of the franchise in regard to age and sex, or in the controversies about proportional representation, or in the matter of compulsory voting, this difference of attitude is apparent.

The electoral system is, then, part of the machinery of government, and the part it plays varies from country to country in accordance with the political system. The number of elective offices may be very large, as in the United States at the present time, or very small, as in Germany before the advent of representative institutions. Or it may, as in most democratic countries, be confined to the legislative assemblies of central and local government. We confine our attention to the central representa

...e assembly, in particular to the lower house, though what we have to say applies almost in every detail to municipal elections. The significance of these electoral systems is determined by the extent to which the sovereignty of the people is admitted by the Constitution but the mere declaration of such sovereignty either in the written Constitution or in the conventional opinion of the day must not be taken as a measure of the rôle of election. One must look to all the other institutions which compose the State: the power of a House of Lords, in Great Britain; presidential powers, as in America, France and Germany, royal power in countries with a constitutional monarchical system. It would be idle, too, after the electoral experience of the last half-century wherever representative institutions have been created, to judge the electoral systems upon their literary form. Every election is a time of intense, though underground pressure of interests, social and economic, in more or less organized form, disturbing constitutional symmetry and abrogating its equity. Threats, intimidation, terrorization and victimization of the most diverse kinds become operative, and in their obvious and indiscreet forms are forbidden by law everywhere. But the economic power of an employer in an industrial country, or a landed proprietor in an agricultural country under modern productive methods is subtle, pervasive and legally unregulated.

Thus, of electoral systems in general we may say that their real meaning depends upon their ultimate governmental effectiveness, their relationship to other political institutions and the social system within which they operate. In considering the subject, then, we ought not to confine our examination to the written text of the franchise acts alone, but must consider an electoral system broadly, as all those means whereby a person becomes a member of an elected assembly, and narrowly, as those means which are sanctioned by the laws. Of ancient practice some account will be found in the article on voting. (*See* VOTE and VOTING.) In modern practice the topics which must be discussed are:—(*a*) candidature; (*b*) returning officer; (*c*) the franchise: qualifications and disqualifications; (*d*) election day; (*e*) ballot; (*f*) expenses and the canvassing of voters; (*g*) representative or delegate; (*h*) non-voting and compulsory voting.

Candidature.—The democratic development of the 19th century and of our own day has generally brought about (1) ease and freedom of candidature, and (2) an approximation of the age limit of candidature to that for the exercise of the vote.

As regards freedom of candidature, the tendency has been to avoid the interference of the State in the electors' choice of candidates, and to restrict the action of the State to providing that ineligibility shall be determined after the election by a tribunal likely to be impartial. Such tribunals are parliamentary as in the United States Federal authority, in Norway, the Netherlands and Belgium or extra-parliamentary as in Great Britain, the Australian Commonwealth and Germany. But statesmen have been unwilling to allow a perfect freedom of candidature, and have sought to secure an element of electoral responsibility by requiring a candidate to be sponsored by a number of electors who sign a nomination form. The number thus required differs very much. For example:—

TABLE I.

Number of electors required to support candidates for lower house

Great Britain	8	Germany	50
Canada	10	Czechoslovakia	100
Portugal	10	Belgium	100
Denmark	25	Italy (1918–22)	300
Holland	25		

The age of candidature and its present approximation to age for the right to vote is observable from table II. (lower house only).

But not all countries now accept the freedom of candidature. Indeed, one of the most remarkable phenomena of modern government is the extent to which the tenets of 19th century democracy have been challenged in this respect. The counter action comes from two quarters: the United States, and Italy and Russia; the source in the first-named country is the excesses of democracy brought about partly by the type of people who are politically active, and partly by the social environment; in the latter it is the plain denial of the politic electoral systems.

TABLE II.

Country							
Russia							
Turkey							
Argentina							
Mexico							
Switzerland							
Germany							
Italy							
Canada							
Czechoslovakia							
Austria							
Poland							
Belgium							
France							
Britain							
U.S.A.							
Norway							
Finland							
Spain							
Japan							
Denmark							
Holland							

RIGHTS OF THE INDI

In the United States, as in Great Brita and Europe, the electoral systems were of the "natural" rights of the individ envisaged was regarded as an independ acting entity, without social or econo those which originated in his self-interes by his private activity, unaided and Thence naturally followed freedom of versal franchise. But men do not act a three-quarters of the way through the more striking than the enormous power exercised by political parties in organizin nor could one mistake the growing si sense of State and its activities and in of men in vocations. The 19th centur upon political parties for the choice o many countries, for other electoral ser of ballot papers. But while the State wa dissolved and recreated by party activi process went on in a fit of statutory abs certainly did not seek to regulate the choice of candidates, and with the exc are about to discuss does not do so now

The States of the United States of suffer from this blithe unconsciousne offices filled by election, the enormou country, and the popular preoccupatic necessitated strong party organization "bosses" fell the nomination of candida nominations as commodities saleable to and excluded voters from the nominat devices; conventions were held witho of-the-way places; they were "packed lists were "padded" and ballot boxes in in the '80s, and the States (Calif as 1866) began to regulate the metho tion, at first permissive, became comp offices were included. In 1912, the p presidency were added. All States, sa established principles and methods f tion of candidates through the party rules (1) to decide which are the pa and this is settled variously by the n

the preceding election or, more frequently, by a fixed proportion of the votes cast, and these range from 2% to 25% of the entire vote; (2) to define those who are entitled to appear at the nominating primaries, that is to define party membership, and this is done by a special enrolment in the party, by secret or open process, some time before the elections; by declaration by ballot when actually at the primary; by decision of the party officials (this in the southern States, where the problem of negro franchise gives trouble); and the Wisconsin method, whereby the voter at the primary votes for the candidate he desires on a ballot paper of his special party colour, which he *secretly* detaches from a perforated pad of ballot papers, each of which represents a different party; (3) the time, place, method of voting and counting are legally regulated.

One question still remains to be solved: how can a citizen get his name placed on the nomination paper at the primary elections? This leads back to the ultimate problem. The methods laid down by the States vary. One method is that of petition which must be signed by a fixed number or an agreed percentage of the voters. This is a very expensive method. In another the party committee nominates long before the election and dissentient elements may by petition present others. One other problem arises: what vote at the primary election constitutes an effective choice of a candidate? Some States require an absolute majority, secured in some places by the second ballot and in others by the alternative vote system; others require at least 35% of the votes to be obtained for a nomination, and if the primary does not secure this, a party convention is called. In Oregon statutory arrangements, at State expense, have been made to give the candidates for candidacy an opportunity of writing their views in a pamphlet printed and circulated by the State.

This system has not notably improved the American electoral systems. The politically conscious electors are still in control of the machine, but the cruder forms of corruption have disappeared. Wirepulling has by no means ceased; it is simply driven back one stage further to the pre-primary arrangements. For the ordinary citizen electioneering has been complicated and the possibility of a clear view of electoral responsibility diminished. Expenses have been increased. Popular interest in the nominations has slightly increased; but nothing can effect a radical change of electoral manners save a change of popular outlook and education.

Another peculiarity of the choice of candidates in the United States is that candidates are by law and custom required to be inhabitants of the State in which they stand. Some States go further and demand that the candidate shall be a resident of the district which he seeks to represent. Many intelligent American observers are agreed that this restriction of choice is seriously detrimental to the quality of American legislatures.

No greater contrast could be presented to the recent developments in the United States than those in Italy and Russia. Italy since 1922 and Russia since 1918 rest upon a political basis which totally denies the individual's right to freedom. Fascism starts out with the whole nation as the unit of State life, and within that unity recognizes the personality of corporations, economic and social, but only as integral elements of the State. The individual has electoral significance in his proper corporation, and the corporation in the State, and it is positively denied that all individuals and all corporations are electorally equal and free. Since 1922 Italian legislation has abolished the democratic electoral system. First (in Nov. 1923) all Fascist candidates were chosen by a central committee for nominations, the list being revised by Mussolini and then, in May 1928, the corporative State having been created by the Fascist regime, a new system was set up. Various corporations were to nominate 900 candidates, the Fascist Grand Council to choose from these some 400 candidates, and these 400 candidates to be put before the electors for approval *en bloc*. (*See* also FASCISM: *Italy*.)

Though the policy of the Union of Socialist Soviet Republics (U.S.S.R.) is much different from the Fascist system, the electoral system is similarly converted to the use of a special organization working within a system which asserts the priority of the State over groups and individuals. The right of nomination as candidates for the Soviet is given to parties, professional organizations, military units, workshops and other vocational units. All this seems to favour a freedom of nomination so long as such nomination issues from a recognized "productive" group. But the Communist Party is all-powerful, and is made so by various *de jure* privileges and its *de facto* capacity to extirpate opposition. Candidature is thus not free in practice.

Candidature may always be taken as a safe guide to the real nature of the political system under discussion. Though we have characterized the systems of Europe as, in general, free, we mean free of legal interference, save for the rules with respect to age nationality and so on. Systems can therefore be graded from the minimum to the maximum of State interference as in the United States, Italy and Russia; but the intentions of those who have interfered are poles asunder. In the countries where there is little or no legislative interference with nomination, there are still local party caucuses who set their own terms for nomination — wealth, beauty, social status, electoral cleverness, even intellect. These caucuses have a great amount of power, though the law has not given it to them; they are representatives of the Idea, and control and organize the money and the workers for the Idea. Where party organization is strong, as in the Anglo-Saxon countries, the party is the deciding factor in the choice of candidates, though this does not mean the central authority of the party. In the Latin countries and in the Balkans, party organization is still too weak to regard such a monopoly as a safe one, and small evanescent groups nominate. In Germany, since the elections to the constituent assembly in 1919, the peculiar nature of its system of proportional representation has made the party machine dominant in the choice of candidates, for the party headquarters wishes to count upon safe seats for certain men and is able to offer safe seats to others out of its national fund of votes accumulated from the votes of unsuccessful candidates at the elections. It can be taken as a fair generalization that, wherever the system of "P.R." operates with what is known as a "list system," the party machine and central control within the party machine has the nominating power strongly in its hands.

ELECTORS' QUALIFICATIONS

The Franchise.—The development of the franchise in the last 100 years has steadily tended towards the abrogation of all electoral inequalities. The principal barrier to a vote was the property qualification, and this has in practically all countries been reduced to a minimum. Stability of citizenship is rather sought in residence qualifications such as the six months' residence or occupation as in Great Britain, six months' residence as in France, a "fixed place of abode" as in Denmark. In the United States residence qualifications range from three months to two years, and in Japan in 1925 male suffrage was enacted for all over 25, resident in their constituency for six months and "with their own means of subsistence." The age for the vote varies a good deal (*see* Table II.). So far no limitation has been put on the oldest age at which one may vote. The variation in age is differently explicable in each country. Russia, where the lowest age pertains, typifies the argument that those who are already industrially productive can be trusted to vote, that the earlier the age at which one begins to vote, within reason, the sooner is one politically educated, and the political system needs the infusion of the spirit of youth. A high age, on the other hand, is counselled by rather conservative minds, who desire youthful rashness to be tempered by mature wisdom.

Women's suffrage (*q.v.*) has conquered most countries, but curiously enough not France, and other Latin countries like Spain, Italy, Portugal, Brazil and Argentine; nor do women vote in Belgium, Greece, Netherlands, Yugoslavia, South Africa or Japan. The attempts made during the 19th century to find an objective determinant of the right to vote in an educational test have been almost universally abandoned. They still exist in the educational tests of the States of the United States of America, but they come to very little, since only ability to read is required. But in the Southern States these tests are used to deprive the negroes of the vote. Brazil and Chile exclude illiterates from the vote and thus

... the former country excludes more than one-half of all male adults. Hungary demands by the law of 1925 that male voters must have had at least three years in elementary schools, and women six. Plural voting is still permitted only in Great Britain, where special educational qualifications confer extra votes, and where university graduates, duly registered, have a vote in respect of their university degree for the member of a university (Oxford, Cambridge, London and the northern universities) but such a vote cannot be used if it would make a third when added to the maximum of two votes acquired by residence or occupation of premises. Under the revision of the constitution in 1921, Belgium had a complicated system of plural voting, introduced in 1893.

The countries we have so far included in our review of franchise qualifications only differ from each other a little in degree, but Russia differs from all others in having adopted the principle of productivity as the basis of the right to vote. In this system the vote is looked upon not as an individual right irrespective of any objective standard of worth, but as a gift of the community to be granted only to those who are productive. The Constitution of 1925 (Article 68a) says "All persons living by productive labour and of a general utility, and also persons employed in domestic economy making it possible for the former to do productive work" shall enjoy the franchise. The definition of productivity is obviously of the essence of this qualification, and that definition has varied since the inception of the Soviet Republic, and varies between locality and locality. In the first flush of the revolution the "bourgeois," that is, the "unproductive" classification, was drawn very widely, but recently, people who receive interest on State or municipal loans have been admitted to the franchise and peasants employing wage-labour are not excluded. Russia differs from other countries in not disqualifying for the vote on account of want of nationality. Productivity and political loyalty are the prime qualifications.

Aliens, convicts and lunatics are well-nigh universally disqualified, and in some countries bankrupts also. In Great Britain peers are not allowed to vote, and until 1918 people in receipt of poor relief within a certain period before the election were disqualified.

The Election.—The time of the year when elections are held, the day of the week, how early the booths are opened and how late shut are important points. In agricultural countries elections (where there are fixed terms of parliament) are fixed after the spring sowing or in autumn after the harvest. The day of the week is especially important in an industrial country, where work must proceed with strictly disciplined regularity. Most European countries have adopted a Sunday or a holiday as election day, but in Great Britain a characteristic muddle-headedness has so far prevented its adoption. The dominions still retain the English practice. In the United States there are laws allowing voters to be absent from work for the time necessary to give their vote. In Great Britain arrangements are made for the polling until 10 P.M.; in Germany and France, where polling does not fall on an ordinary work-day, it ends at 6 P.M.

Other countries were earlier than Great Britain in adopting the system of one-day elections. A longer period has certain advantages, but the single day has the decided advantage of reducing the economic effects of electioneering excitement. The one-day election is practically universal.

SECRECY OF THE BALLOT

The Process of Polling.—Around the process of polling great parliamentary fights were waged in the 19th century, and the issue was to secure (1) The freedom of the voter from outside influence and, (2) the honesty of the counting of the votes. The first was secured by (*a*) the proper organization of the presidency of the whole electoral procedure; (*b*) by the institution of the secret ballot, and (*c*) more recently by associating the representatives of the contending parties with the supervising officer of the proceedings.

The proper organization of the presidency involved the appointment of a public official, sometimes of the central authority like the *Préfet* (*see* PREFECT) in France, or a local government authority like the town clerk in Great Britain, or in the United States. The intention of the representative assemblies was rarely corrupt; but corruption did creep in, and is still not altogether excluded in countries like France, Hungary, Rumania, Poland and Greece where the Government of the day does not hesitate to impress the returning officers that the elections must be "made." And in the State and city politics of the United States the parties and the "bosses" are not yet entirely of the opinion that returning officers should be just. There are many points at which the power of the returning officer may be corruptly used: the permission of personation (*q.v.*), the "stuffing" of ballot boxes, the verification of title and the acceptance of doubtful votes. On the whole, the tendency is towards greater integrity in these matters, but party watchers and the representatives of civic associations cannot afford to relax their vigilance.

South Australia was the first State to introduce secrecy of the ballot (1856), since when it is usual to find the secret ballot referred to as the Australian ballot. Thence the system spread to Europe and America to meet the growing public and parliamentary demand for protection of voters. The means for securing secrecy vary very much. Perhaps the most careful arrangements are to be found in Germany, that is, in the elections for the Federal authority, and it may be taken that the various States closely follow its practice. The voting urns are required to be four-cornered, of certain dimensions and closed, the only aperture being a small slit at the top. These urns are examined before the poll begins and must not be opened until the count begins. The voter indicates his choice by placing his list of candidates (Germany has a strict list system of proportional representation) into an officially stamped envelope. The latter is given to him by an official, and no other envelope is legally valid. This envelope is made of opaque paper of a statutorily determined size. The voter places his ballot into the envelope in a special stall called an isolation cell (*Isolierzelle*), which is so arranged as to make observation by anybody, officials or other voters, impossible. An election was once challenged in the *Reichstag* because even the feet of a voter were observable. The envelope containing the ballot is then given by the voter to the returning officer, who takes the name of the voter, verifies his title, and then puts the vote into the urn.

Variations of this procedure now exist all over the world, the substantial part thereof being the secrecy of choice. In Hungary, by the electoral rules of April 1922, all rural constituencies numbering 200 out of a total of 245 are subject to open voting. In Great Britain the secret ballot was finally introduced for all parliamentary and municipal elections by the Ballot Act of 1872. In the United Kingdom, as in the British dominions generally, the ballots are officially provided and issue from a counterfoiled volume, but no envelope is provided, and the voter casts his ballot directly into the urn. Until 1913 the French system was full of defects: the candidates circulated the ballots even outside the polling-sections, and the voter merely folded the paper and gave it to the presiding official to put into the ballot box. After 1913 the "envelope system" was adopted (law of July 1913, modified by law of March 31, 1914). Since Oct. 1919 also, the State prints the ballots, though at the expense of the candidates, and sends them to the voters by post under an official stamp. No voter can be offered ballots on election day except from the returning officer's staff inside the polling-station. Before 1884 the general practice in the United States was either open voting, or where this rudimentary and clumsy process had been superseded, voting by ballot. After the presidential elections of 1884 the Australian ballot system was extensively adopted. Now without exception ballots are printed at the public expense, distributed in the polling stations, officially numbered, secretly marked and folded, and are identifiable by reference to the counterfoil retained by the official.

In the United States a great controversy has long raged around the question, how far the party organization ought to interfere with the voter by putting emblems on the ballot. Until recently the ballot was so arranged that the voter had only to mark the

ballot paper at one certain polling station and thus indicated his acceptance of all the candidates of any one party. America has attempted to forestall such assaults upon the independence of voters by such plans as the Massachusetts plan, adopted there in 1888. All the names of candidates *for all parties* for each office are placed in alphabetical order under the title of the office. The only way to vote is to mark a cross opposite the name of each candidate desired. The law so far compromises with the competence of the voter that it allows the printing of the party name or emblem by the side of each name. In many States the party signs are forbidden, especially for municipal offices.

Political parties are associated with the administration of the ballot in the better-organized democracies to an interesting but not surprising extent. In Great Britain agents of the candidates are allowed to be present at the polling station. They are sworn to secrecy and may not interfere with a voter. They are present at the count of votes and raise objections to spoiled or uncertain ballot papers. The clerks are appointed by the public authority. In the United States the parties have a larger share in the electoral proceedings. Besides the rights given by British law, American laws provide for the clerical work to be done by people chosen by the parties. In Germany the presence of representatives of the candidates is permitted, on the general principle of publicity of proceedings, and in each constituency the presiding officer appoints from three to six electors from the political parties to act as supervisors and clerks during the proceedings and at the counts. In much the same way the Czechoslovakian law provides for the conduct of the elections by a departmental commission (the local authority) with the collaboration of members of all parties. In France the parties have no such connection with electoral procedure.

ELECTIONEERING TACTICS

The Influencing of Voters.—Though, in practice, many voters cast their votes for candidates they know nothing about, it is rarely the fault of the candidates. It is of the essence of their desire to represent others that they should make clear to their constituents their purposes and character. Indeed, the large number of constituents for each representative in the modern State compels the creation of a machine and methods to impress the others. Representation is unthinkable, under modern social conditions, on any other basis. Candidates have rarely conceived their task as one simply of enlightening the electors. The attitude of a John Stuart Mill or a Macaulay is a rarity. The candidate, and certainly his party followers and workers, as well as his agent, want victory, and this desire too often causes them to adopt tactics which they alone would be likely to confound with enlightening the elector. There is a class of acts—large, not easily definable—which causes undue or unfair influence, making impossible any rational vote and destroying that elusive entity, the "real will" of the electors. Laws have therefore been made restraining injurious activity, and they can be broadly divided into two classes, those regulating the expenditure at elections, and those defining and creating penalties for corrupt practices.

In Great Britain, the Corrupt and Illegal Practices Act of 1883 codified and added to the piecemeal legislation of previous centuries, making a code of admirable strictness. Corrupt practices include: (1) *Bribery* by gift, loan or promise of money or money's worth to vote or abstain from voting; by offer or promise of a situation or employment to a voter or any one connected with him, by giving or paying money for the purpose of bribery, by gift or promise to a third person to procure a vote, or payment for loss of time, wages or travelling expenses to secure a vote; and the consequences are the same whether bribery is committed before, during or after an election. (2) *Treating*, which means the provision or payment for any person, of meat, drink, entertainment or provision, at any time, in order to induce him, or any other person to vote or abstain from voting—and such extends to the wives or relatives of voters. (3) *Undue influence, i.e.*, the making use, or the threatening to make use of any force, violence or restraint, or inflicting or threatening to inflict any temporal or spiritual injury on any person in order to influence his vote, or by duress or fraud impeding the free exercise of the franchise by any man. (4) *Personation* (q.v.) applying for a ballot paper in the name of another person, whether alive or dead, voting twice at the same election, aiding or abetting personation, forging or counterfeiting a ballot paper. (5) *Unauthorized expenditure*. That expenditure which is not authorized in writing by the election agent. Illegal practices include paid conveyancing, advertising, and hiring, without authority, committee rooms; voting without qualification; false statements made about candidates, disturbance of public meetings between the issue of the election writ and the return of the election; printing, publishing or posting any bill, placard or poster not bearing on its face the name and address of the printer and publisher; illegal proxy voting. Heavy fines and withdrawal of the right to vote or be a candidate are attached to these offences. The expenses of the candidates were limited by the act of 1883 and now, after the passage of the Reform Acts of 1918 and 1928 stand at 3d. per elector in a borough constituency and 6d. per elector in a county constituency.

Nothing, however, has been done to prevent party headquarters giving aid to a candidate as an organization not in his pay and in a general fashion. Poorer candidates and party organizations have much to complain of, nor can any close observer of elections deny that richer candidates can and do have materially more influence. The conveyance of voters to the poll in hired vehicles is prohibited. But it is a well known fact that candidates and their agents have found ways and means of driving many a motor car through this clause of the act. Nor are the parties which have a legitimate right to contest an election always ready to do so, for they are restrained by the fear of unpopularity, whether they succeed or not. Thus widely illegal and corrupt practices go unpunished. The dominions have codes of electoral propriety closely resembling that of the Mother Country and offer no conspicuous variations.

Among European countries Hungary, Rumania, Bulgaria and Greece have been pre-eminent in the corruption of their political systems. In the United States three means of corruption have been used: money, public office and serious forms of undue influence. It has been estimated by Prof. Charles Merriam that the two major parties alone in only a presidential campaign spend together some $20,000,000. Money is also freely spent in smaller contests; sums of over $100,000 have been spent on the election of a single person to the Senate. An official enquirer (Senator Kenyon, chairman of the Senate committee on privileges and elections, U.S.A., 1921) was justified in calling these sums "a present and growing menace to the nation," even when allowance is made for the wide tracts of land to be covered in the United States in an election campaign. Besides money the party leaders had as election currency thousands of Federal, State and local offices in their gifts, but these, since 1883, are being gradually withdrawn from the "spoils" system. From the office-holders on the "spoils" system collections of a percentage of their salaries were made for the party funds; but these assessments are now in the process of extinction. Since 1890 many laws have sought to regulate electoral sincerity, and they have concentrated upon publicity of the source and destination of campaign funds, have sought to secure reports of personal service; some States (*e.g.*, Alabama, Kentucky, Minnesota, New Jersey, Wisconsin and several others), even going so far as to require accounts and reports several days prior to the election. The laws have gone a long way towards defining and enumerating legitimate expenditure and illegitimate means of influence. Some States (Alabama, Minnesota, Massachusetts and Wisconsin), require that all political advertisements shall be signed and marked "Paid advertisement," stating the price paid, the advertiser and the author. In the three latter States and Kansas the purchase of newspaper support is forbidden. These laws have done much good. While party managers have not been wholly restrained from that class of immoral electoral behaviour now prohibited by statute, their task has been made more difficult to a point which has forced many to become honest. One contribution of American practice to electoral procedure is the introduction of the *Publicity Pamphlet*. Oregon in 1908 passed a law requiring all candidates to take at fixed rates from one to four pages of a pamphlet published and sent to all

[illegible] and subject to the law of libel. [illegible] other States have adopted this system, but it has worked best in its native State. On the whole these publicity pamphlets have no more value than assembled copies of the English election addresses which are printed by the candidates, and one mail of which may be sent to parliamentary electors at the State's expense.

French law on corrupt practices was codified in the decree of Feb. 1852, but little heed was taken of its provisions until the laws of July 29, 1913, and March 31, 1914, redefined the offences and created severe penalties. A light is thrown upon French electoral procedure when we remark that in the latter statute Government pressure is expressly condemned.

It is always necessary to remember that there is much "influence" which is impalpable but very effective—not usually exercised wholesale, but in the form of individual pressure, difficult to detect or to resist. A shopkeeper, for example, may fear to express his opinions by exhibiting the placard he favours; a policeman may be taken off his guard by a popular local politician, and other known party workers may be victimized in a way which, to the outer eye, appears economically fair. In the Southern States of the United States the negro problem has found a partial solution in variously devised qualifications for the vote, but one must add to the total means of racial discrimination the opinion of the white neighbourhood, which may at any time be supported by injustices done in the law courts, rough handling and even lynching.

Recent electoral proceedings in the more populous countries, such as France, Germany and Great Britain have shown two characteristics of much importance. The first is the increased rowdiness at election meetings. This is undoubtedly due to what may be called the maturity of the franchise. The vote has been given to practically all adults, and these have been simultaneously persuaded that the political struggle may give wealth and power to some and take it from others. Intolerance is bound to be the consequence of such a conviction, and it issues in the attempt to stop opponents from stating their case. The second is the use of the microphone for broadcasting speeches. While in the United States this form of political speaking was effectively used by both leading candidates in the 1928 presidential election, it has not reached its full development in other countries.

Majority and Minority Representation.—Three systems of representation are at present operative. There are countries like Great Britain and most of the States of the United States of America, where however many candidates stand for a single available seat the one candidate who tops the list by however little over the next below him is elected. This is called the plurality majority system, and it is not difficult to see that since all the unsuccessful candidates may have between them more than 50% of the votes cast, the majority may be unrepresented. In order to avoid such inequity two principal methods have been invented: the second ballot, as operative in France and other European countries who have no proportional representation system, and the alternative vote. In the former, where no candidate obtains an absolute majority, *i.e.*, anything over 50% of the total votes cast, a second ballot takes place, in which all unsuccessful candidates are at once or progressively excluded, an absolute decision between the two candidates finally remaining being ultimately arrived at. The alternative vote is the method which secures the benefits of the second ballot at a single election, the voter marking the candidates on his ballot paper with a series of preferences 1, 2, 3 and so on—whence the method is sometimes called the preferential vote. This is much used in Australia. Many countries, notably Belgium, Holland and Germany have adopted a system of proportional representation, that is, methods of casting and counting ballots which allow of a representation of political opinion in fairly strict proportional representation. The respective merits and demerits of these systems are dealt with in the article on PROPORTIONAL REPRESENTATION.

Delegate and Representative.—Once the candidate has succeeded in getting elected, is he to act upon instructions and formally [illegible] the constituency or to use his discretion on broad [illegible] the welfare of the whole country? Until recent years the generally accepted view was that the elected person is a *representative* and has no particular mandate. This theory was embodied in France in the Constitution of Sept. 3, 1791 (sec. 3, art. 7): "The representatives chosen in the departments shall not be representatives of a particular department, but of the entire nation, and no one may give them any instructions (*mandat*)." The theory and even the words of the article have been copied by most countries since in their written Constitutions. In England much the same theory was enunciated by Edmund Burke in his speech to the sheriffs of Bristol (1780), but with less abstract dogmatism. The 19th century has witnessed the triumph of the French view over new forms of political organization. The prime movers in political life became political parties, propagandist organizations and organized economic groups like trade unions. They demand an adherence not to their strict instructions, but to their general principles, and it is a general, though not a legal rule, that the member who finds himself in plain [illegible] his supporting group must explain the ground[illegible]. In Europe, outside Russia, it is generally recognized that the member cannot do his best work without a certain amount of independence. On the whole, Burke's view is accepted. "Look, gentlemen, to the *whole tenor* of your member's conduct. . . . He may have fallen into errors: he must have faults; but our error is greater and our fault is radically ruinous to ourselves if we do not bear, if we do not even applaud, the whole compound and mixed mass of such a character . . . if by a fair, by an indulgent, by a gentlemanly behaviour to our representatives, we do not give confidence to their minds, and a liberal scope to their understandings; if we do not permit our members to act upon a *very* enlarged view of things, we shall at length infallibly degrade our national representation into a confused and shuffling bustle of local agency." It is, indeed, a nice balance which has to be kept. But the claims of the organized electors have received greater validity in Russia than elsewhere. There, quite plainly, the mandate of the whole people is denied, and the system of the *definite and imperative* mandate has been adopted. By the Constitution of 1925 (art. 63, and the previous Constitution of 1918), the members of the soviets are obliged to report regularly to their electors on their action, and art. 75 gives the electors the right to revoke their mandate at any time and elect another member. The congresses have reiterated this right and power and urged its employment. About a dozen States in the United States have the system of the *recall* for controlling the activity of members both of the legislative and of the administration. It is actually used chiefly against local officials and arouses intense electoral interest.

Non-voting and Compulsory Voting.—A disturbing phenomenon in all electoral systems is the small percentage of actual voters. In England the parliamentary vote is normally about 70% of its full strength; in France it is not much over 60%, in Germany it is often over 75%, and in the United States, where the word "non-voting" was invented, presidential elections have had as great a proportion as 80% voting; but in other elections, State and local, there is a great falling off. The best extant study of non-voting is that by Prof. H. Gosnell of Chicago university, who found by actual research the following causes in the degree expressed in Table III., p. 139.

We cannot say how far the percentages fit conditions outside Chicago for that particular election, but the causes of non-voting as analyzed and defined in this study are useful clues. Non-voting has caused considerable anxiety to the supporters of democracy and it is natural that reformers should have hit upon the idea of compulsory voting. Switzerland, Spain, Argentine, Bulgaria, Austria, New Zealand, Czechoslovakia, Holland and Belgium have penalties for non-voters—all of them with the exception of Holland and Czechoslovakia dating from before the war. The Australian Commonwealth adopted a system in 1924. Belgium, which has enforced its law most stringently, began to compel voters as early as 1893 with the penalty of a fine of from one to three francs or a reprimand for the first omission to vote,

TABLE III

Reas [illegible]

Reasons for not voting	No.	Per cent distribution
All reasons	5,310	100·0
Physical difficulties:		
Illness	647	12·1
Absence	589	11·1
Detained by helpless member of family	115	2·2
Legal and administrative obstacles:		
Insufficient legal residence	274	5·2
Fear of loss of business or wages	289	5·5
Congestion at polls	44	0·8
Poor location of polling booth	45	0·8
Fear of disclosure of age	14	0·3
Disbelief in voting.		
Disbelief in woman's voting	414	7·8
Objections of husband	54	1·0
Disgust with politics	230	4·3
Disgust with own party	105	2·0
Belief that one vote counts for nothing	79	1·5
Belief that ballot box is corrupted	40	0·7
Disbelief in all political action	22	0·4
Inertia:		
General indifference	1,347	25·4
Indifference to particular election	129	2·5
Neglect: intended to vote but failed	448	8·4
Ignorance or timidity regarding elections	378	7·1
Failure of party workers	47	0·9

for a second omission within six years a fine of from three to 25 francs; for a third omission within ten years a similar penalty and the exhibition of the offender's name on a placard outside the town hall for a month. The fourth omission in 15 years brings about a more serious punishment: similar fines and the removal of the elector's name from the register for ten years, during which time he may receive from the State no promotion, distinction or nomination to public office in local or central Government. Though the franchise has been greatly widened since 1893 the abstentions have never been higher than 7·5% (in 1896) and in 1900 were 6%, and in 1912 only 4%. Altogether, from 1899–1912 it needed 24,819 convictions of various degrees (about 10,000 being reprimands) to secure this result. The main question is: is it worth while spending the energy and money required to make voters exercise the vote? Is the vote, as some consider it, a right, or as others, a civic duty? (H. Fi.)

ELECTORS (Ger. *Kurfürsten*), a body of German princes, with whom rested the election of the German king, from the 13th until the beginning of the 19th century. Before the middle of the 13th century German kings had succeeded to their position partly by heredity and partly by election. Primitive Germanic practice had emphasized the element of heredity. *Reges ex nobilitate sumunt:* the man whom a German tribe recognized as its king must be in the line of hereditary descent from Woden; and therefore the genealogical trees of early Teutonic kings (as, for instance, in England those of the Kentish and West Saxon sovereigns) are carefully constructed to prove that divine descent which alone will constitute a proper title. Even from the first, however, there had been some opening for election; for the principle of primogeniture was not observed, and there might be several competing candidates, all of the true Woden stock. One of these competing candidates would have to be recognized; and to this limited extent Teutonic kings may be termed elective from the very first. In the other nations of western Europe this element of election dwindled, and the principle of heredity alone received legal recognition; in mediaeval Germany, on the contrary, the principle of heredity, while still exercising an inevitable natural force, sank formally into the background, and legal recognition was finally given to the elective principle.

This difference between the German monarchy and the other monarchies of western Europe may be explained by various considerations. Not the least important of these is what seems a pure accident. Whereas the Capetian monarchs, during the 300 years that followed on the election of Hugh Capet in 987, always left an he[illegible]r male and an heir mal[illegible] o[illegible] [illegible] age, the German kings again and again, during the same period either left a minor to succeed to the throne or left no issue at all. The principle of heredity began to fail because there were no heirs. Again the strength of tribal feeling in Germany made the monarchy into a prize, which must not be the apanage of any single tribe, but must circulate, as it were, from Franconian to Saxon, from Saxon to Bavarian, from Bavarian to Franconian, from Franconian to Swabian; while the growing power of the baronage, and its habit of erecting anti-kings to emphasize its opposition to the Crown (as, for instance, in the reign of Henry IV.), coalesced with and gave new force to the action of tribal feeling. Lastly, the fact that the German kings were also Roman emperors finally and irretrievably consolidated the growing tendency towards the elective principle. The principle of heredity had never held any great sway under the ancient Roman empire (*see* under EMPEROR); and the mediaeval empire, instituted as it was by the papacy, came definitely under the influence of ecclesiastical prepossessions in favour of election. Heredity might be tolerated in a mere matter of kingship; the precious trust of imperial power could not be allowed to descend according to the accidents of family succession. To Otto of Freising (*Gesta Frid.* ii. 1) it is already a point of right vindicated for itself by the excellency of the Roman empire, as a matter of singular prerogative, that it should not descend *per sanguinis propaginem, sed per principum electionem.*

The accessions of Conrad II., Lothair II., Conrad III., and Frederick I. had all been marked by an element, more or less pronounced, of election. That element is perhaps most considerable in the case of Lothair, who had no rights of heredity to urge. Here we read of ten princes being selected from the princes of the various duchies, to whose choice the rest promise to assent, and of these ten selecting three candidates, one of whom, Lothair, is finally chosen (apparently by the whole assembly) in a somewhat tumultuary fashion. In this case the electoral assembly would seem to be, in the last resort, the whole diet of all the princes. But a *de facto* pre-eminence in the act of election is already, during the 12th century, enjoyed by the three Rhenish archbishops, probably because of the part they afterwards played at the coronation, and also by the dukes of the great duchies—possibly because of the part they also played, as vested for the time with the great offices of the household, at the coronation feast. In fact the votes of the archbishops and dukes, which would first be taken, would of themselves, if unanimous, decide the election. To prevent tumultuary elections, it was well that the election should be left exclusively with these great dignitaries; and this is what, by the middle of the 13th century, had eventually been done.

The chaos of the interregnum from 1198 to 1212 showed the way for the new departure; the chaos of the great interregnum (1250–73) led to its being finally taken. The decay of the great duchies, and the narrowing of the class of princes into a close corporation, some of whose members were the equals of the old dukes in power, introduced difficulties and doubts into the practice of election which had been used in the 12th century. The contested election of the interregnum of 1198–1212 brought these difficulties and doubts into strong relief. The famous bull of Innocent III. (*Venerabilem*), in which he decided for Otto IV. against Philip of Swabia, on the ground that, though he had fewer votes than Philip, he had a majority of the votes of those *ad quos principaliter spectat electio*, made it almost imperative that there should be some definition of these principal electors. The most famous attempt at such a definition is that of the *Sachsenspiegel*, which was followed, or combated, by many other writers in the first half of the 13th century. Eventually the contested election of 1257 brought light and definition. Here we find seven potentates acting—the same seven whom the Golden Bull recognizes in 1356; and we find these seven described in an official letter to the pope as *principes vocem in hujusmodi electione habentes, qui sunt septem numero.* The doctrine thus enunciated was at once received; and by the date of the election of Rudolph of Habsburg (1273) the seven electors may be regarded as a definite body, with an acknowledged right: The pope having already acknowledged it in two bulls (1263)

The Golden Bu[illegible] [illegible] ...e duke of Bavaria claimed as his proper right the electoral vote which had been assumed by the king of Bohemia: and the practice of *partitio* in electoral families tended to raise further difficulties about the exercise of the vote. The Golden Bull of 1356 settled both these questions. Bohemia (of which Charles IV., the author of the Golden Bull, was himself the king) was assigned the electoral vote in preference to Bavaria; and a provision annexing the electoral vote to a definite territory, declaring that territory indivisible, and regulating its descent by the rule of primogeniture instead of partition, swept away the old difficulties which the custom of partition had raised. After 1356 the seven electors are regularly the three Rhenish archbishops, Mainz, Cologne and Trier, and four lay magnates, the palatine of the Rhine, the duke of Saxony, the margrave of Brandenburg and the king of Bohemia: the three former being vested with the three archchancellorships, and the four latter with the four offices of the royal household (*see* HOUSEHOLD). (2) The rights of the seven electors in their collective capacity as an electoral college, were a matter of dispute with the papacy. The result of the election was in itself simply the creation of a German king—*an electio in regem*. But since 962 the German king was also, after coronation by the pope, Roman emperor. Therefore the election had a double result. the man elected was not only *electus in regem*, but also *promovendus ad imperium*. The difficulty was to define the meaning of the term *promovendus*. Must the elected king be promoted inevitably to the imperial crown, or did such promotion depend on the discretion and subsequent action of the papacy? Boniface VIII. pressed the latter view against Albert I. in 1298, even though his election was unanimous; and John XXII. expressed it in its harshest form, when in 1324 he excommunicated Louis IV. for using the title even of king without previous papal confirmation. This action ultimately led to a protest from the electors, whose right of election would have become practically meaningless if such assumptions had been tolerated. A meeting of the electors (*Kurverein*) at Rense in 1338 declared (and the declaration was reaffirmed by a diet at Frankfurt in the same year) that the act of election conveyed both kingship and empire without any need of papal assent. The doctrine thus positively affirmed at Rense is negatively reaffirmed in the Golden Bull, in which a significant silence is maintained in regard to papal rights. But the doctrine was not always in practice followed and Sigismund, for example, did not venture to dispense with papal approbation.

By the end of the 14th century the position of the electors, both individually and as a corporate body, had become definite and precise. Individually, they were distinguished from all other princes, as we have seen, by the indivisibility of their territories and by the custom of primogeniture which secured that indivisibility; and they were still further distinguished by the fact that their person, like that of the emperor himself, was protected by the law of treason, while their territories were only subject to the jurisdiction of their own courts. Powerful as they were, however, in their individual capacity, the electors showed themselves no less powerful as a corporate body. As such a corporate body, they may be considered from three different points of view, and as acting in three different capacities They were an electoral body, choosing each successive emperor; they were one of the three colleges of the imperial diet (*see* DIET); and they were also an electoral union (*Kurfürstenverein*), acting as a separate and independent political organ even after the election, and during the reign, of the emperor. It was in this last capacity that they had met at Rense in 1338; and in the same capacity they acted repeatedly during the 15th century. According to the Golden Bull, such meetings were to be annual, and their deliberations were to concern "the safety of the empire and the world." Annual they never were; but occasionally they became of great importance. Again and again, from 1424 to 1530, attempts were made by the electoral union to erect a new central Government, either composed of its members or acting under their influence and control, by the side of the emperor. There was one such attempt in 1424; another in 1453; and a third, [illegible] ...ous [illegible] ...ch Be[illegible]...d of Mainz as prom[illegible] ... Bu[illegible] the oppo[illegible] of the emperors combined with the forces of German disunion to shipwreck every attempt.

In the course of the 16th century a new right came to be exercised by the electors. As an electoral body (*i.e.*, in the first of the three capacities distinguished above), they claimed, at the election of Charles V. in 1519 and at subsequent elections, to impose conditions on the elected monarch, and to prescribe the terms on which he should exercise his office in the course of his reign. This *Wahlcapitulation*, similar to the *Pacta Conventa* which limited the elected kings of Poland, was left by the diet to the discretion of the electors, though after the treaty of Westphalia an attempt was made, with some little success, to turn the capitulation into a matter of legislative enactment by the diet. From this time onwards the only fact of importance in the history of the electors is the change which took place in the composition of their body during the 17th and 18th centuries. From the Golden Bull to the early years of the 17th century the composition of the electoral body had remained unchanged. In 1623, however, in the course of the Thirty Years' War, the vote of the count palatine of the Rhine was transferred to the duke of Bavaria; and at the treaty of Westphalia the vote, with the office of imperial butler which it carried, was left to Bavaria, while an eighth vote, along with the new office of imperial treasurer, was created for the count palatine. In 1708 a ninth vote, along with the office of imperial standard-bearer, was created for Hanover; while finally, in 1778, the vote of Bavaria and the office of imperial butler returned to the counts palatine, as heirs of the duchy, on the extinction of the ducal line, and the new vote created for the Palatinate in 1648, with the office of imperial treasurer, was transferred to Brunswick-Lüneburg (Hanover) in lieu of the vote which this house already held. In 1806, on the dissolution of the Holy Roman Empire, the electors ceased to exist.

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ELECTRA, a city of Wichita county, Texas, U.S.A., 10m. from the Red river (the northern boundary of the State), at an elevation of 1,220ft. above sea-level. It is on Federal highway 370 and the Fort Worth and Denver City railway. The area is one square mile. The population was 4,744 in 1920 (98.5% native white), and was estimated locally at 10,000 in 1928. In 1892 a town-site was platted on the ranch of W. T Waggoner, around Beaver Post Office (established 1890), and in 1902 the name was changed to Electra, in honour of Waggoner's daughter. The population had reached only 640 in 1910, but early in 1911 the discovery well in the Electra oil-field (1m. N.) was completed, and by the end of that year there were about 5,000 inhabitants. In 1925 the production of the field was 6,294,455 barrels, and the city had three refineries, eight casinghead gasolene plants, a tank factory and two machine shops making oil-field tools, besides cotton gins, grain elevators, a creamery and a chick hatchery with a capacity of 20,000 eggs. The assessed valuation of property was $4,238,785. The city was incorporated in 1917. It has a commission form of government.

ELECTRA, the name of three Greek legendary figures. (Ἠλέκτρα, Doric Ἀλέκτρα, "bright one"). (1) Daughter of Oceanus, wife of Thaumas, and by him mother of Iris and the Harpies; sister of Styx. (Hesiod, *Theog.*, 265 ff., cp. 349 ff.). (2) One of the Pleiads (*q.v.*); mother by Zeus of Dardanus, the ancestor of the Trojan royal family. This detail is post-Homeric, the genealogy in the *Iliad* beginning with Dardanus, whose mother is not named, Il., xx., 215. She is regularly said to have lived in Samothrace, where once or twice the Cabiri are identified with her sons, although several authorities connect her, or her children, also with Arcadia and Crete, and a late and artificial account makes her an Italian, wife of Corythus. Iasion, the lover of Demeter (*q.v.*) is also her son by Zeus and

qu n he a d Ze s a e the paren of Harm n.a q n m a e au or he b ng the Paladium to Troy for her son (schol. Eurip., *Phoen.*, 1136), or her star is the dim Pleiad, which lost its splendour when Troy fell (Hygin., *Fab.*, 192; Servius Danielis on Virg., *Georg.*, I., 138). For these and other stories *see* Furtwängler in Roscher's *Lexikon*, I. col. 1234–35. (3) Daughter of Agamemnon (*q.v.*) and Clytaemestra (not named in the Homeric list of his daughters, Il., ix., 145, 287), and apparently first in Stesichorus, or Xanthus, (Aelian, *Var. Hist.*, iv. 26), where she is said to have been identified with the Homeric Laodice. In the tragedians who certainly follow the lost *Oresteia* of Stesichorus, in some particulars at least, she rescues Orestes, then a child, at the time of Agamemnon's murder, and sends him with an old servant to Phocis for safe keeping (so Sophocles; in Aeschylus he had already been sent away before the return of his father). She herself remains with her mother, enduring all manner of insult and ill-treatment and remaining unmarried (in Euripides, she is nominally married to a commoner, who respects and guards her). At length, Orestes, now a man, returns secretly and with the help of Electra entraps Aegisthus and Clytaemestra (the stratagem he uses is variously given), and kills them both. Electra then marries Pylades. Many variants, some very complicated (*e g.*, Hygin., *Fab.*, 122) exist.

See Aeschylus, *Choephoroe;* Sophocles and Euripides, *Electra*, with Jebb's introduction to his edition of the former for an account of the handling of the theme in literature, ancient and modern; also the mythological handbooks, and the articles in Roscher's *Lexikon* and Pauly-Wissowa, *Realencyclopädie.*

ELECTRICAL ARTICLES. The general article will be found under ELECTRICITY; related subjects are dealt with under ELECTRIC GENERATOR; MOTORS, ELECTRIC; ELECTRICAL MACHINE; ELECTRICITY, ATMOSPHERIC; ELECTRICITY, CONDUCTION OF; ACCUMULATOR; BATTERY; and ELECTRON. Electric Power is dealt with under ELECTRICAL POWER: *National and Regional Schemes;* ELECTRIC POWER IN AGRICULTURE; ELECTRICITY SUPPLY: *Commercial Aspects;* ELECTRICITY SUPPLY: *Technical Aspects;* and ELECTRIFICATION OF INDUSTRY.

Other articles are ELECTRIC FURNACES; INSTRUMENTS, ELECTRICAL; ELECTROMAGNETISM; ELECTROMETALLURGY; ELECTROPLATING; ELECTROCUTION and ELECTROTHERAPY. Articles relating to lighting are found under ELECTRIC LAMPS AND VALVES, MANUFACTURE OF; LIGHTING; and ILLUMINATING ENGINEERING. Articles on electric transport are found under RAILWAYS, ELECTRIFICATION; LOCOMOTIVES, ELECTRIC; TRAMWAYS; TRACTION, ELECTRIC; and TRANSPORT. Electricity as concerned with communication is dealt with under TELEPHONE; TELEGRAPH; BROADCASTING; WIRELESS; and RAILWAYS: *Signalling.*

ELECTRICAL ENGINEER is one who is able to conduct or direct work involving the theory and practical application of electricity. The work of the electrical engineer may include research design, construction, operation and management, and also teaching and writing on any of these branches. The practical application of electricity, in which the great majority of electrical engineers are employed, may be divided into generation, distribution, control and utilization of electrical energy. Utilization may include use of mechanical power produced by electrical devices as in transportation and industrial-machine operation, illumination, communication, electrochemistry, electrometallurgy, electrical heating, measuring by electrical means, and use of electronic forces as in X-rays, cathode rays, etc.

ELECTRICAL INSTRUMENTS: *see* INSTRUMENTS, ELECTRICAL.

ELECTRICAL (or ELECTROSTATIC) **MACHINE,** a machine operating by manual or other power for transforming mechanical work into electric energy by the separation of electrostatic charges of opposite sign delivered to separate conductors. Electrostatic machines are of two kinds: Frictional, and Influence.

Frictional Machines.—A primitive form of frictional electrical machine was constructed about 1663 by Otto von Guericke (1602–1686). It consisted of a globe of sulphur fixed on an axis and rotated by a winch, and it was electrically excited by the friction of warm hands held against it. Sir Isaac Newton appears to have been the first to use a glass globe instead of sulphur (*Opticks*, 8th Query). F. Hawksbee in 1709 also used a revolving glass globe. A metal chain resting on the globe served to collect the charge. Later G. M. Bose (1710–1761), of Wittenberg, added the prime conductor, an insulated tube or cylinder supported on silk strings, and J. H. Winkler (1703–1770), professor of physics at Leipzig, substituted a leather cushion for the hand. Andreas Gordon (1712–1751) of Erfurt, a Scotch Benedictine monk, first used a glass cylinder in place of a sphere. Jesse Ramsden (1735–1800) in 1768 constructed his well-known form of plate electrical machine (fig. 1). A glass plate fixed to a wooden or metal shaft is rotated by a winch. It passes between two rubbers made of leather, and is partly covered with two silk aprons which extend over quadrants of its surface. Just below the places where the aprons terminate, the glass is embraced by two insulated metal forks having the sharp points projecting towards the glass, but not quite touching it. The glass is excited positively by friction with the rubbers, and the charge is drawn off by the action of the points which, when acted upon inductively, discharge negative electricity against it. The insulated conductor to which the points are connected therefore becomes positively electrified. The cushions must be connected to earth to remove the negative electricity which accumulates on them. It was found that the machine acted better if the rubbers were covered with bisulphide of tin or with F. von Kienmayer's amalgam, consisting of one part of zinc, one of tin and two of mercury. The cushions were greased and the amalgam in a state of powder spread over them. Edward Nairne's electrical machine (1787) consisted of a glass cylinder with two insulated conductors, called prime conductors, on glass legs placed near it. One of these carried the leather exciting cushions and the other the collecting metal points, a silk apron extending over the cylinder from the cushion almost to the points. The rubber was smeared with amalgam. The function of the apron is to prevent the escape of electrification from the glass during its passage from the rubber to the collecting points. Nairne's machine could give either positive or negative electricity, the first named being collected from the prime conductor carrying the collecting points and the second from the prime conductor carrying the cushion.

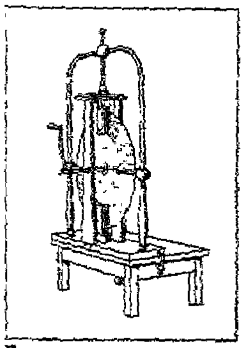

FIG. 1.—RAMSDEN'S ELECTRICAL MACHINE

Influence Machines.—Frictional machines are, however, now quite superseded by the second class of instrument mentioned below, namely, influence machines. These operate by electrostatic induction and convert mechanical work into electrostatic energy by the aid of a small initial charge which is subsequently replenished or reinforced in an accumulative manner. The general principle of all the machines described below will be best understood by considering a simple ideal case. Imagine two Leyden jars with large brass knobs, A and B, to stand on the ground (fig. 2). Let one jar be initially charged with positive electricity on its inner coating and the other with negative, and let both have their outsides connected to earth. Imagine two insulated balls A′ and B′ so held that A′ is near A and B′ is near B. Then the positive charge on A induces two charges on A′, viz.: a negative on the side nearer and a positive on the side more remote. Likewise the negative charge on B induces a positive charge on the side of B′ nearer to it and repels negative electricity to the far side. Next let the balls A′ and B′ be connected together for a moment by a wire N called a neutralizing conductor which is subsequently removed. Then A′ will be left negatively electrified and B′ will be left positively electrified. Suppose that A′ and B′ are then made to change places. To do this we shall have to exert energy to remove A′ against the attraction of A and B′ against

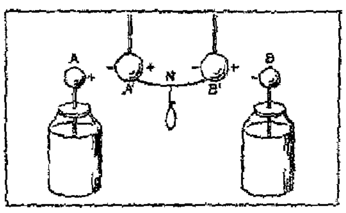

FIG. 2.—LEYDEN JAR APPARATUS WITH BRASS KNOBS

the attraction of B. Finally let A' be brought in contact with B and B' with A. The ball A' will give up its charge of negative electricity to the Leyden jar B, and the ball B' will give up its positive charge to the Leyden jar A. This transfer will take place because the inner coatings of the Leyden jars have greater capacity with respect to the earth than the balls. Hence the charges of the jars will be increased. The balls A' and B' are then practically discharged, and the above cycle of operations may be repeated. Hence, however small may be the initial charges of the Leyden jars, by a principle of accumulation resembling that of compound interest, they can be increased as above shown to any degree or, at least, until the losses due to incomplete insulation do not outweigh the gain of charge of either conductor in the same time. If this series of operations be made to depend upon the continuous rotation of a winch or handle, the arrangement constitutes an electrostatic influence machine. The principle therefore somewhat resembles that of the self-exciting dynamo.

Bennet's Doubler.—The first suggestion for a machine of the above kind seems to have grown out of the invention of Volta's electrophorus. Abraham Bennet, the inventor of the gold leaf electroscope, described a *doubler* or machine for multiplying electric charges (*Phil. Trans.*, 1787).

The principle of this apparatus may be explained thus. Let A and C be two fixed disks, and B a disk which can be brought at will within a very short distance of either A or C. Let us suppose all the plates to be equal, and let the capacities of A and C in presence of B be each equal to p, and the coefficient of induction between A and B, or C and B, be q. Let us also suppose that the plates A and C are so distant from each other that there is no mutual influence, and that p' is the capacity of one of the disks when it stands alone. A small charge Q is communicated to A, and A is then insulated, and B, uninsulated, is brought up to it, the charge on B will be $-(q/p)Q$. B is now uninsulated and brought to face C, which is uninsulated; the charge on C will be $(q/p)^2Q$. C is now insulated and connected with A, which is always insulated. B is then brought to face A and uninsulated, so that the charge on A becomes rQ, where

$$r = \frac{p}{p+p'}\left(1+\frac{q^2}{p^2}\right).$$

A is now disconnected from C, and here the first operation ends. It is obvious that at the end of n such operations the charge on A will be r^nQ, so that the charge goes on increasing in geometrical progression. If the distance between the disks could be made infinitely small each time, then the multiplier r would be 2, and the charge would be doubled each time. Hence the name of the apparatus.

Nicholson's Doubler.—Erasmus Darwin, B. Wilson, G. C. Bohnenberger and J. C. E. Peclet devised various modifications of Bennet's instrument (*see* S. P. Thompson, "The Influence Machine from 1788 to 1888," *Journ. Soc. Tel. Eng.*, 1888, 17, p. 569). Bennet's *doubler* appears to have given a suggestion to William Nicholson (*Phil. Trans.*, 1788, p. 403) of "an instrument which by turning a winch produced the two states of electricity without friction or communication with the earth." This "revolving doubler," according to the description of Professor S. P. Thompson (*loc. cit.*), consists of two fixed plates of brass A and C (fig. 3), each two inches in diameter and separately supported on insulating arms in the same plane, so that a third revolving plate B may pass very near them without touching. A brass ball D two inches in diameter is fixed on the end of the axis that carries the plate B, and is loaded within at one side, so as to act as a counterpoise to the revolving plate B. The axis P N is made of varnished glass, and so are the axes that join the three plates with the brass axis N O. The axis N O passes through the brass piece

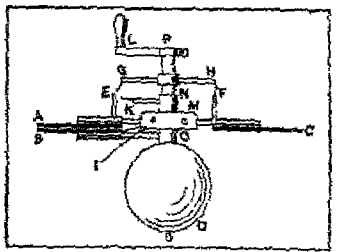

FIG. 3.—NICHOLSON'S RECEIVING DOUBLER

M, which stands on an insulating pillar of gla plates A and C. At one extremity of this axi the other is connected with a rod of glass fixed the handle L, and also the piece G H insulated. The pins E, F rise out of the bacl A and C, at unequal distances from the ax parallel to G H, and both of them are furn with small pieces of flexible wire that they E, F in certain points of their revolution. F M there stands out a pin I, to touch against or spring which projects sideways from the ro it comes opposite A. The wires are so adjus B, at the moment when it is opposite A, con ball D, and A communicates with C throug revolution later C, when B comes opposite with the ball D through the contact of K w positions A, B, C and D are completely disc other. Nicholson thus described the operatio

"When the plates A and B are opposite fixed plates A and C may be considered as revolving plate B, together with the ball another mass. All the experiments yet made these two masses will not possess the same The redundant electricities in the masses und be unequally distributed; the plate A will ha parts, and the plate C one; and, for the same ing plate B will have ninety-nine parts of the and the ball D one. The rotation, by desti preserves this unequal distribution, and carrie the same time that the tail K connects the b In this situation, the electricity in B acts u produces the contrary state, by virtue of between C and the ball; which last must t electricity of the same kind with that of the r the rotation again destroys the contact and r situation opposite A. Here, if we attend to th revolution, we shall find that the electric stat masses have been greatly increased; for the A and B remain, and the one part of electr increased so as nearly to compensate ninet opposite electricity in the revolving plate B, cation produced an opposite mutation in th ball. A second rotation will, of course, pro augmentation of these increased quantities, a turning will soon bring the intensities to th is limited by an explosion between the pl 1788, p. 405).

Nicholson described also another appar condenser," which worked on the same pri Nicholson were followed by T. Cavallo, J berger, C. B. Désormes and J. N. P. Hachette and others in the invention of various forms of rotating doubler.

Belli's Doubler.—A simple and typical form of doubler, devised in 1831 by G. Belli (fig. 4), consisted of two curved metal plates between which revolved a pair of balls carried on an insulating stem. Following the nomenclature usual in connection with dynamos we may speak of the conductors which carry the initial charges as the field plates, and of the moving cond induced the charges which are subsequently the field plates, as the carriers. The wire armature plates for a moment is the neutrali two curved metal plates constitute the field p original charges imparted to them of opposit balls are the carriers, and are connected tog by a wire when in a position to be acted upc field plates, thus acquiring charges of opposit after they are separated again. The rotatior thus negatively charged is made to give up

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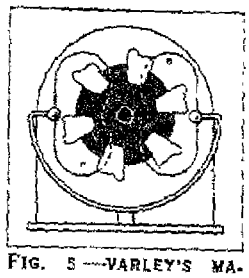


FIG. 5.—VARLEY'S MACHINE

otation, the positively charged car-
e by touching a little knob attached
d similarly for the negative charge
s on the field plates were continually
Varley also constructed a multiple
ring six rotating disks, each having a
ing between field plates. With this
s 6 in. long, the initial source of
Daniell cell.

was followed by A. J. L. Toepler,
influence machine consisting of two
and rotating in the same direction.
of tin-foil extending nearly over a
o field plates, one behind each disk;
vely and the other negatively elec-
ere touched under the influence of
l on and gave up a portion of their
hat of the negative field plate; in
ch were touched under the influence
t a part of their charge to augment
. In this apparatus one of the charg-
ne of the field plates, but the other
opposite to the other field plate.
would always remain charged when
smitting terminals.

1864 and 1880, W. T. B. Holtz
large number of influence machines
sidered the most advanced develop-
ostatic machine. In one form the
Holtz machine consisted of a glass disk mounted on a horizontal axis F (fig. 6) which could be made to rotate at a considerable speed by a multiplying gear, part of which is seen at X. Close behind this disk was fixed another vertical disk of glass in which were cut two windows B, B. On the side of the fixed disk next the rotating disk were pasted two sectors of paper A, A, with short blunt points attached to them which projected out into ay from the rotating disk. On the sk were placed two metal combs C, points set in metal rods and were pair of discharge balls E, D, the d be varied. To start the machine ntact, one of the paper armatures electricity, and disk set in motion. hissing sound was heard and the turn as if the disk were moving After that the discharge balls might be eparate a h e nd a con nuous series o spa ks or brush discharges vou d ke place be.ween .nem. If two Leyden jars L, L were hung upon the conductors which supported the combs, with their outer coatings put in connection with one another by M. a series of strong spark discharges passed between the discharge balls. The action of the machine is as follows: Suppose one paper armature to be charged positively, it acts by induction on the right hand comb. causing negative electricity to issue from the comb points upon the glass revolving disk; at the same time the positive electricity passes through the closed discharge circuit to the left comb and issues from its teeth upon the part of the glass disk at the opposite end of the diameter. This positive electricity electrifies the left paper armature by induction, positive electricity issuing from the blunt point upon the side farthest from the rotating disk. The charges thus deposited on the glass disk are carried round so that the upper half is electrified negatively on both sides and the lower half positively on both sides, the sign of the electrification being reversed as the disk passes between the combs and the armature by discharges issuing from them respectively. If it were not for leakage in various ways, the electrification would go on everywhere increasing, but in practice a stationary state is soon attained. Holtz's machine is very uncertain in its action in a moist climate, and has generally to be enclosed in a chamber in which the air is kept artificially dry.

Voss Machine.—Robert Voss, a Berlin instrument maker, in 1880 devised a form of machine in which he claimed that the principles of Toepler and Holtz were combined. In the Holtz machine the collecting system CEDC (fig. 6) served also as the neutralizing conductor. In the Voss an additional neutralizing conductor was placed at an angle with the former. In addition on a rotating glass or ebonite disk were placed carriers of tin-foil or metal buttons against which the neutralizing brushes touched. This plate revolved in front of a field plate carrying two pieces of tin-foil backed up by larger pieces of varnished paper. The studs on the front plate were charged inductively by being connected for a moment by the neutralizing wire as they passed in front of the paper armatures on the stationary plate, and then gave up their charges partly to renew the field charges and partly to collecting combs connected to discharge balls. In general design and construction, the manner of moving the rotating plate and in the use of the two Leyden jars in connection with the discharge balls, Voss borrowed his ideas from Holtz.

Wimshurst Machine.—All the above described machines, however, were thrown into the shade by the invention of a greatly improved type of influence machine first constructed by James Wimshurst about 1878. Two glass disks are mounted on two shafts in such a manner that, by means of two belts and pulleys worked from a winch shaft, the disks can be rotated rapidly in opposite directions close to each other (fig. 7). These glass disks carry on them a certain number (not less than 16 or 20) tin-foil carriers which may or may not have brass buttons upon them. The glass plates are well varnished, and the carriers are placed on the outer sides of the two glass plates. As therefore the disks revolve, these carriers travel in opposite directions, coming at intervals in opposition to each other. Each upright bearing carrying the shafts of the revolving disks also carries a neutralizing conductor or wire ending in a little brush of gilt thread. The neutralizing conductors for each disk are placed at right angles to each other. In addition there are collecting combs which occupy an intermediate position and have sharp points projecting inwards, and coming near to but not touching the carriers. These combs on opposite sides are connected respectively to the inner coatings of two Leyden jars whose outer coatings are in connection with one another.

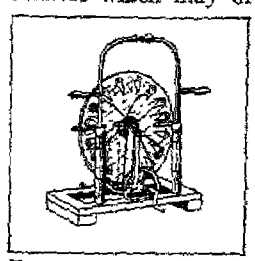


FIG. 7.—WIMSHURST'S MACHINE

The operation of the machine is as follows: Let us suppose that one of the studs on the back plate is positively electrified and one at the opposite end of a diameter is negatively electrified, and that at that moment two corresponding studs on the front

passing opposite to these back studs are momentarily con- d together by the neutralizing wire belonging to the front The positive stud on the back plate will act inductively on ront stud and charge it negatively, and similarly for the stud, and as the rotation continues these charged studs pass round and give up most of their charge through the s to the Leyden jars The moment, however, a pair of studs e front plate are charged, they act as field plates to studs on ack plate which are passing at the moment, provided these re connected by the back aliaing wire. After a few itions of the disks half the on the front plate at any nt are charged negatively alf positively and the same e back plate, the neutralin- ires forming the boundary en the positively and nega- charged studs. The dia- in fig. 8, taken by permis- from S. P. Thompson's (*loc. cit.*), represents a of the distribution of these es on the front and back respectively. It will be seen that each stud is in turn both a plate and a carrier having a charge induced on it, which then on in turn and induces further charges on other studs. hurst constructed very powerful machines of this type, some m with multiple plates, which operate in almost any climate, rely fail to charge themselves and deliver a torrent of sparks en the discharge balls whenever the winch is turned. He evised an alternating current electrical machine in which the rge balls were alternately positive and negative. Large hurst multiple plate influence machines are often used in- of induction coils for exciting Röntgen ray tubes in medical particularly in countries where other sources are not avail- but they cannot compete with sources depending upon elec- gnetism when great power is required. They give very illumination on fluorescent screens.

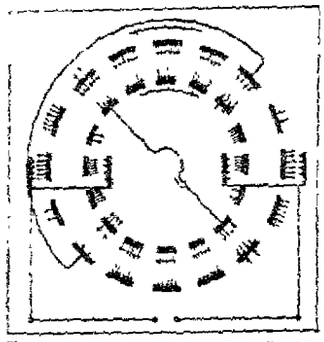


FIG. 8.—ACTION OF THE WIMS- HURST MACHINE

1900 it was found by F. Tudsbury that if an influence ne is enclosed in a metallic chamber containing compressed r, better, carbon dioxide, the insulating properties of com- d gases enable a greatly improved effect to be obtained to the diminution of the leakage across the plates and from pports. Hence sparks can be obtained of more than double ength at ordinary atmospheric pressure. In one case a ne with plates 8 in. in diameter which could give sparks at ordinary pressure gave sparks of 5, 7, and 8 in. as the

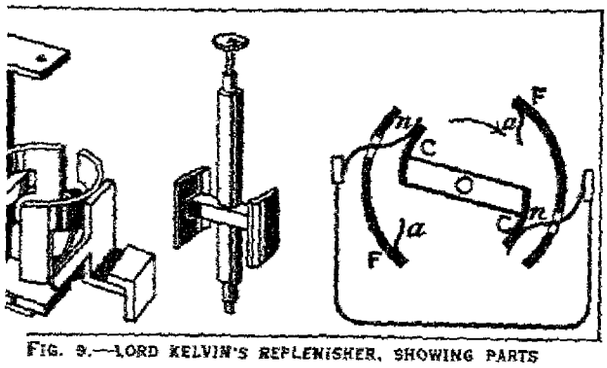


FIG. 9.—LORD KELVIN'S REPLENISHER, SHOWING PARTS

re was raised to 15, 30 and 45 lb. above the normal sphere.

action of Lord Kelvin's replenisher (fig. 9) used by him in ction with his electrometers for maintaining the charges, resembles that of Belli's doubler and will be understood fig 9. Lord Kelvin also devised an influence machine, com- called a "mouse mill," for electrifying the ink in connection his siphon recorder. It was an electrostatic and electro- etic machine combined, driven by an electric current and cing in turn electrostatic charges of electricity. In con- nection with this subject mention must also be made of the water dropping influence machine of the same inventor[1]

The action and efficiency of influence machines have been investigated by F. Rossetti, A. Righi and F. W. G. Kohlrausch. The electromotive force is practically constant no matter what the velocity of the disks, but according to some observers the inter nal resistance decreases as the velocity increases. Kohlrausch using a Holtz machine with a plate 16 in. in diameter, found that the current given by it could in 40 hours only electrolyse acidulated water sufficient to liberate one cubic centimetre of mixed gases. This means that the current was less than one thousandth of an ampere. E. E. N. Mascart, A. Roiti and E Bouchotte have also examined the efficiency and current-producing power of influence machines

BIBLIOGRAPHY.—In addition to S. P. Thompson's valuable paper on influence machines (to which this article is much indebted) and other references given, *see* J. Clerk Maxwell, *Treatise on Electricity and Magnetism* (2nd ed., Oxford, 1881), vol. i., p. 294; J. D. Everett, *Electricity* (expansion of part iii. of Deschanel's *Natural Philosophy*) (London, 1901), *ch. iv.*, p. 20; A. Winkelmann, *Handbuch der Physik* (Breslau, 1905), vol iv., pp. 50–58 (contains a large number of references to original papers); J. Gray, *Electrical Influence Machines, their Development and Modern Forms* (London, 1903). The design of influence machines is very fully discussed in V. Schaffers, *La Machine à Influence* (1908). (J. A. F.; A. W. Po.)

ELECTRICAL POWER: NATIONAL AND REGIONAL SCHEMES. The 20th century has witnessed the world-wide development of national and regional schemes of electrical power generation and transmission. Development has been very unequal in different countries. Thus, in the United States, with its possession of magnificent coalfields, oilfields, natural gas supplies and water-power, the schemes have been based upon varied resources scattered over an enormous territory. In Italy, on the other hand, where coal is, for practical purposes, non-existent, but where there is a fine store of power in lake and mountain stream, the regional plans made have been almost entirely based upon transmission from gigantic hydro-electric generating stations. In Great Britain, where water-power is comparatively small, while the coalfields are fine and extensive, the plans made are necessarily based chiefly upon generation from the coal supply. In Great Britain development of electrical power generation and transmission has been notably behind that of several other countries, although long before the World War S. Z. Ferranti, when president of the Institute of Electrical Engineers, devoted his presidential address to concrete proposals to establish super-power stations, on the British coalfields and at other places to which coal could be economically transported, to create an all-electrical power-supply. Half a generation was, however, to elapse before British legislation set up a central board to develop a British national electric system.

In the following sections is given an account of the regional electrical power schemes of Great Britain, Germany, France, Italy, Switzerland, Holland and other European countries, and of Canada, followed by a description of the extensive developments which have taken place in the United States. (L. C. M.)

EUROPEAN ELECTRICAL SCHEMES

Great Britain.—The British public service of electricity supply has been carried out by local authorities and by power companies, the former accounting for about 64·5% of the total production by public undertakings. A number of tramway, railway, water-power and aluminium undertakings, not to be directly classified with public utilities, produce an additional 18 per cent. In 1927 the number of supply undertakings with distributing rights were 623, possessing 491 generating stations with a total output, in 1927–28, of 8,550,000,000 units. To these should be added railway, tramway and non-statutory undertakings possessing 79 stations with a production of 1,450,000,000 units, so that the real national total in that year was 10,000,000,000 units.

Acting on the report of a special committee, presided over by Lord Weir, dealing with the power situation, the Government de-

[1] *See* Lord Kelvin, *Reprint of Papers on Electrostatics and Magnetism* (1872); "Electrophoric Apparatus and Illustrations of Voltaic Theory," p. 319; "On Electric Machines Founded on Induction and Convection," p. 330: "The Reciprocal Electrophorus, p 337

cided to introduce legislation reinforcing the acts of 1919 and 1922 and establishing a central electricity board which would have a constitution similar to that of an industrial company outside of direct Parliamentary control. The functions of the central board, as constituted in the Electricity (Supply) Act of 1926, were to develop a national super-power system, erect main transmission lines to cover the whole country, to finance standardization of frequency so that one standard of transmission and distribution could be adopted—namely, that of 50 cycles—to take over the output of all the stations selected to supply the country under the new scheme, and to sell it to authorized distributors at cost price.

It was estimated that, by 1940–41, the national production of electricity would be 25,000,000,000 units, supplied by 60 stations with a total installed capacity of about 11,000,000 kw. The average working cost of electricity, when such concentration had been effected, would fall from .94d. as recorded in 1925–26 to less than .4d. per unit, while the large industrial consumer would be able to obtain his power requirements at ½d. per unit, and the national average for all supplies would lie in the vicinity of 1d.

The central electricity board worked on a triple programme:—

(a) The creation of giant power stations located in the main industrial areas under the control of public supply undertakings.

(b) The construction of a main transmission system operating at a pressure of 132,000 volts, so that the entire country would be held in a power ring or series of power rings radiating out from the giant power stations. To this system would be attached also smaller secondary lines tapping agricultural and other outlying areas.

(c) Standardization of frequency in the areas where 50 cycles were not used for generation and distribution—namely, on the North-East Coast, in the west of Scotland and in the area covered by Birmingham corporation and the Shropshire, Worcestershire and Staffordshire Electric Company in the Midlands.

All three developments were estimated to reach a first point of completion in 1934–35, when the main transmission system would have been constructed, and the greater part of the conversion to a standard frequency effected in the west of Scotland and the Midlands.

The zones surveyed and under construction in 1927 were South-East England, which included London and the surrounding area, with a population, according to the census of 1921, of 11,400,000; Central England, covering the five shires of Leicester, Northampton, Stafford, Warwick and Worcester, with a population of 5,218,000; Lancashire and North Wales; Yorkshire; Northumberland and Durham; Lincolnshire; South-West England and South Wales; North-West England; Central Scotland and probably Northern Scotland.

By April 1928, three main power zones had been surveyed and definite schemes of development drawn up for them—the three being South-East England, Central England and Central Scotland. These three areas, with a combined population of 21,000,000 and an estimated output for 1941 of 11,760,000,000 units produced in power stations with a total capacity of 4,668,000 kw., represented three of the most important industrial and economic areas in Great Britain, responsible for the maintenance of 48 per cent. of the entire population. The fourth great scheme, devoted to South-East Lancashire, was due to be published in June 1928, and the remaining zones were to be surveyed and designed before the end of 1929, so that the actual work of constructing the main transmission system and of bringing the whole national production of electricity into a scientific scheme would be definitely initiated by 1930.

Under full development—*i.e.*, by 1940–41—it was estimated that main transmission and standardization of frequency would account for an expenditure of between £30 and £35 millions, all to be incurred by the central board, which would raise the capital required for this purpose in the open market with a Treasury guarantee, while the supply undertakings owning the selected stations and furnishing the central board with their entire output would probably expend on generation alone about £120 millions. The elaboration of distribution systems connecting the consumer to the main transmission zones would account for an additional £100 millions, so that the average annual expenditure on electricity supply alone would not be far short of £250 millions.

Germany.—The progress of electricity supply in Germany has been similar to that of Great Britain. Much the same problems had to be overcome and the legislative measures destined to advance reorganization were based on the same principles in Germany as in Britain.

In Britain the national production of electricity has been spread over a number of undertakings, few of them large enough to take advantage of modern technical and administrative experience, in Germany, small undertakings have been even more firmly established. Thus, inclusive of industry, the total number of power stations in 1925 was 7,492 and of this number 6,930 were responsible for an output of 3,313,000,000 units, and 562 for 17,015,000,000 units. Thus 85 per cent. of the national production was concentrated in 562 power stations.

The most spectacular developments were associated with the large corporations, and through their activities a number of super-power zones were determined by 1927 in Germany. Thus, in Central Germany, the *Elektrowerke A.G.* (State-owned) developed a main transmission system from its three super-power stations at Zschornewitz, Lauta and Trattendorf, operating at 110,000 volts. This system covered the whole of the brown-coal area of Central Germany, fed into Berlin and extended into Lower Silesia with connections to Breslau. In Saxony proper it linked up with the system elaborated by the *Sächsische-Werke* (owned by the State of Saxony), which owned two main generating stations at Hirschfelde and Böhlen with a smaller plant at Chemnitz. This undertaking supplied Dresden and fed into Leipzig as well as Lower Silesia. To the south-west, at Herlasgrün, it was connected to the 110,000 volt system constructed by the *Bayernwerk*, which, obtaining its electricity from the water-power plant owned by the *Walchensee-Werk A.G.* at Walchensee and the *Mittlere-Isar A.G.* on the Isar, was supplying electricity north to Nuremberg and Bamburg, and, at Höchst, came into the super-power zone controlled by the *Rheinisch-Westfälisches E.W.* From Nuremberg to Regensburg a main transmission line had been constructed to bring the Kachlet water-power plant into the Bavarian scheme. Through Kachlet the southern German zone was connected with the Austrian system. Further south, through Stuttgart, it came again, at Karlsruhe, into touch with the super-power zone owned by the *Badenwerk*, and in this way was able to tap the giant brown-coal stations of the Ruhr and the water-power stations of the Black Forest and the Alps.

The fourth great zone had been elaborated by the *Rheinisch-Westfälisches E.W.*, operating from its giant station at Knapsack, interconnected with smaller stations at Reisholz, Essen and the Fortuna station of a different company which supplied Cologne. This undertaking constructed main transmission lines at 110,000 volts as far north as the Dutch border, and was connected with Dutch undertakings. To the south it constructed a 220,000 volt line from Knapsack to Coblenz and Mannheim, with a further projection through Stuttgart to the Swiss Alps. Its main line would ultimately operate at 380,000 volts and connect the Swiss water-power resources with the Ruhr and with Holland. A fifth smaller zone was served by the *Badenwerk*, with a system extending from Ludwigshafen to Homberg in the west, Karlsruhe, Villingen and Laufenburg in the south.

Secondary transmission lines operating at 33,000 to 80,000 volts radiated out from these main systems to cover wide areas in the south and in the centre of Germany. The result was that, under full development, five series of great power rings may operate in Germany: one extending from the Ruhr north to Emmerich and north-east to Bremen and Emden; a second from the Ruhr to Nienberg and thence north-east to Hanover, Herschel, Borken, Frankfurt, Höchst, returning to the Ruhr; a third covering the whole of southern Germany with its northern limits at Frankfurt, its south-western at Laufenburg, its south-eastern at Walchensee, its eastern at Kachlet and the eastern frontier, and its north-eastern at Herlasgrün. The fourth power ring was composed of the two systems operated by the *Elektrowerke A.G.* and the *Sächsische-Werke*, covering Saxony and feeding into Berlin; while the fifth ring covered Lower Silesia. Under full development, one great ring will surround the whole of Germany between the

Ruhr, Berlin, Silesia, Saxony, Bavaria, Württemberg and Baden.

This had been very largely the work of the mixed supply corporation, where the model of the private industrial company had been adopted, with a majority public control in administration and finance, and these undertakings were due to become more and more important in the production of electricity. Thus, in 1927, the *Elektrowerke* accounted for an output of 1,678,000,000 units, the *Rheinisch-Westfälisches E.W.* for 1,450,000,000 units, the *Sächsische-Werke* for 538,000,000 units, the *Bayernwerk* for 450,000,000 units, the *Badenwerk* for 250,000,000 units, while the *Berliner Elektrizitätswerke*, which was linked up with the system of the *Elektrowerke*, produced over 700,000,000 units, and the *Hamburgische Elektrizitätswerke*, 320,000,000 units. These seven undertakings accounted for a total of almost 5,500,000,000 units, the greater part of which was derived from brown-coal and water-power stations.

France.—The main principles at issue in France, as in Britain and Germany, were:—

1. The construction of efficient super-power stations interconnected to create power pools;
2. The exploitation of water-power sites with a view to effecting the maximum economy in fuel, with interconnection of the steam generating stations with these water-power stations to permit of the exchange of energy;
3. The elaboration of a high-pressure transmission system which would link up the main power zones, permit of railway electrification on the largest possible scale, and transform the whole country ultimately into one great power system.

Five power zones could be distinguished in 1927:—

1. The coal-mining and textile areas of the Nord and Pas-de-Calais
2. Paris
3. The Meurthe et Moselle
4. The Massif Central
5. The Pyrenees.

The reconstruction of the devastated territories made it possible to equip French coal-mines with the most modern machinery and to carry out a complete scheme of electrification. Thus the Nord and Pas-de-Calais became one of the most highly electrified coal-mining areas in the world, already supplied by a number of highly efficient stations located at the pit-heads, using waste fuel and waste heat, and interconnected to effect the fullest possible exchange of energy. The main stations located in this area were Comines, Pont-à-Vendin, Beuvry, Bully, Harnes, Seguedin, Wasquehal, Lomme, Valenciennes and Sin-le-Noble. The total productive capacity of the area was in excess of 1,200,000,000 units, and the main connecting lines operated at 45,000 volts. Through Maubeuge, Hirson and Mézières, this zone was linked up with the Meurthe et Moselle, while an elaborate system operating at the same voltage brought it, through the power station at Beaugarde and the transforming stations at Laon and Soissons, to the outskirts of the Paris zone, so that interconnection with the latter can be effected easily when necessary.

In Paris, the situation had become so simplified through reorganization that four undertakings supplied power for the entire zone. They were, in order of importance:—*Union d'Electricité*, with super-power stations at Gennevilliers (340,000 kw.), Vitry (90,000 kw.) and Vitry-Sud (100,000 kw.) under construction; the *Compagnie Parisienne de Distribution d'Electricité* at Issy-les-Moulineaux (130,000 kw.) and Saint-Ouen (400,000 kw.); the *Société d'Electricité*, with the Saint-Denis station (120,000 kw.); and the *Société d'Electricité de la Seine* at Ivry (under construction, 1928). All these stations, with the exception of Saint-Denis, were interconnected by underground cables operating at 60,000 volts, while from Gennevilliers overhead transmission lines at 60,000 volts branched out to Creil. Paris was encircled by a high-pressure power ring capable of developing 1,000,000 kw., while an additional 200,000 kw. projected in 1927 would bring the total plant capacity of the zone to 1,200,000 kw. by the end of 1929. The total productive capacity of the area, under full development, would be in excess of 4,000,000,000 units.

In 1928 the Paris power scheme could be regarded as almost fully developed, but in the Meurthe et Moselle area important plans were under consideration in 1927 which would render it almost as important as Paris. The consumption of electricity in the area was, in 1924–25, 600,000,000 units, while it might be estimated at 1,400,000,000 units in 1935, equivalent to a generating plant capacity in the latter year of 520,000 kw.

A second significant move could be seen in the authorization granted in 1927 to the *Société des Forces Motrices du Haut Rhin* to build a water-power station at Kembs. This meant that one of the biggest water-power schemes in Europe would be begun within a short time. The exploitation of the Rhine, according to the scheme, should mean the construction of eight generating plants along the river from Kembs to Strasbourg, with a total final capacity of 581,500 kw.

In the *massif central* and in the Pyrenees, water-power provided the main source of energy. From the new super-power station at Chancy-Pougny on the Rhone, a main transmission line operating at 100,000 volts went north-west via Le Creusot to Dijon, while large stations were projected at Bellegarde, Maty, Balley, Bregnier, Le Sault Brenaz and Villette d'Anthon, all the stations being ultimately interconnected, and feeding into Lyons, which was already supplied from one water-power plant and three steam-power stations. From Lyons, one main transmission line operating at 100,000 volts went to Villefranche in the north, Albertville and Moutiers in the east, with a second main transmission line finishing at the Viclaire water-power station on the Italian frontier. Further south, new schemes were under consideration, covering Salembert, Tournon, Valence, Montélimar, Villeneuve-les Avignon. With the completion of these schemes, the Rhone area would become one of the most important in France.

The supply undertakings in the Pyrenees area were grouped together in a central association, with an annual output of more than 600,000,000 units. One main transmission line at 100,000 volts ran from Toulouse to Lannemezan as far as Pau, and supplied power to the important electrified railway of the *Midi* company, linking up at that point with the main transmission system running between Laruns, Dax and Bordeaux. Under full development, the *massif central* and the Pyrenees should be interconnected through Albi, Le Truel and Monistrol, while main connections would run north to Strasbourg, or link up with Swiss companies and would join the elaborate system already in existence in the Meurthe et Moselle and Alsace-Lorraine areas. In the centre the construction of the main transmission line from Paris to the large water-power plant at Eguzon and thence to Champagnac and Le Truel should complete the system of interconnection, and transform the country into one scientifically developed power zone. In 1927, the consumption of electricity in France was in excess of 11,000,000,000 units, about 45 per cent. of which was supplied from water-power stations.

Italy.—Even more spectacular developments in electricity supply than in France took place in Italy after 1919. While, according to the official returns of the minister of finance in Italy, the consumption of electricity rose from 2,553,000,000 units in 1914–15 to 3,696,000,000 units in 1919–20—an increase of 45 per cent. in five years—it rose from 4,021,000,000 units in 1920–21 to 7,363,000,000 units in 1925–26—an increase in the second five years of 83 per cent.

The capacity of water-power plant installed at the end of 1927 in undertakings accounting for 90 per cent. of the national production was 2,116,932 kw., and of steam-power plant 555,269 kw.—a total of 2,672,200 kw. If we assume that the capacity of generating plant corresponded closely to the state of production, Italy had, at the end of 1927, 3,300,000 kw. of generating plant installed. The important areas which lay north of a line drawn from east to west through Rome represented one of the most highly developed power zones in the world.

In northern Italy, the Edison group of companies, with an annual production of slightly more than 2,000,000,000 units, had been the great co-ordinating force. Allied with it were three main groups, one connected with the *Societa Idroelettrica Piemonte*, the Adamello Group, and the Adriatic Group which was active in Venetia and supplied electricity as far south as Bologna. In the areas supplied by the Edison group, main transmission lines operating at 110,000 volts ran from the Swiss frontier at Campodolcino, north of Lake Como to Piacenza, Parma and

Bologna. The second system branched out from the completed group of water power plants installed north of Pedimulera with connections into Switzerland to Novara, ending at Arquata north of Genoa, with a branch stretching between Gozzano and Brugherio outside of Milan, to link up with the system already mentioned.

In the Adamello area, one main transmission line of 110,000 volts ran from the north of Edolo to Gorlago, thence to Parma ending at San Polo d'Enza. In the Trentino a main transmission line of the same voltage went from Milan down the valley of the Adige also to San Polo d'Enza, while in the Adriatic area Belluno in the valley of the Piave was connected to Porto Maggiore and Bologna. Those were the main transmission lines in Northern Italy, but secondary systems operating at lower voltages radiated out to connect the main centres of consumption with the generating stations and transmission systems. Thus the entire region provided a perfect example of a power pool developed on scientific lines.

In central Italy, developments had been less notable, since no considerable industrial area existed. In southern Italy proper, the development of large power schemes on the Sila necessitated main transmission between the main water-power plants and Taranto and Bari, with a secondary line running from that point to Benevento, Naples, with connections leading into Rome, Ascoli, and ultimately Ancona.

The entire country had been accurately surveyed with the result that electricity could be transmitted, if necessary, from the Alps as far south as the toe of Italy, and interchange take place readily between central Italy and the Alpine companies.

A further development lay in the erection of lines of 220,000 volts to supplement those already in existence, while energy was imported in increasing bulk from Switzerland. In Dec. 1927, for example, 16,000,000 units were imported from that country. On the Ligurian frontier interconnection had been effected with the French system operated by the *Energie Electrique du Littoral Méditerranéen*, while the development of power schemes on the Brenner would allow it to exchange energy with Austria.

Switzerland.—In Switzerland the development of electricity supply had not been quite so rapid since the war as in Italy or France, because it was already highly developed. Even so, the total capacity of generating stations at the end of 1927 was 1,485,000 h.p., an increase of 151 per cent. over 1914.

The large public supply company had been established in certain areas, often with high pressure transmission lines. The *Nordostschweizerische Kraftwerke A.G.*, with an annual output of 550,000,000 units, owned an elaborate main transmission system with its centre in Winterthur. From Winterthur main transmission lines operating at 45,000 volts went up to Schaffhausen and thence into Germany, while, to the south-east, it reached Löntsch power station and linked up at Siebnen with the main high pressure system operated by the municipality of Zurich. From Beznau to the west of Winterthur, it constructed a line at 132,000 volts leading to Basle and thence into France.

The second large company, the *Bernische Kraftwerke*, with an annual output of 500,000,000 units, operated due south of Basle with main transmission lines at 45,000 volts connecting Basle and Berne, stretching south to Spiez and thence to the Rhone valley, where it linked up with the system of the Lonza Company. From Berne, the system went north-north-west into France, to feed into the area supplied by the *Electricité de Strasbourg*. Main transmission lines at 150,000 volts connected this system with central Switzerland at Lucerne. A third company, the *E. W. Lonza* (150,000,000 units) operated in the Rhone valley from Naters almost to the head of Lake Geneva. It fed directly at Monthey into the system of the Freiburg company, whose main transmission line, operating at 32,000 volts, joined the Rhone valley system at Neuchatel and that of the French company exploiting the river Doubs. A fourth main system was constructed by the *E. W. Olten-Aarburg* (320,000,000 units) with its centre in Aarau. This company's lines, at 40,000 to 45,000 volts, were connected with Germany via Laufenburg, and fed into France through the tunnel at Basle while further west, it was linked up with the *Compagnie Lorraine d'Electricité*.

These four companies and the Swiss federal railways were responsible for the greater part of the main transmission system extending over northern and central Switzerland and the Rhone valley, while, in the south, two companies, the *Officine Elettriche Ticinesi* and the *Kraftwerke Brusio* (with an annual production in excess of 250,000,000 units), brought the Swiss Alpine power system into touch with the Italian at Lugano and Campocologno. Further schemes, associated with the *Kraftwerke Laufenburg* (350,000,000 units) and the *E. W. Rybourg-Schwörstadt* (550,000,000 units) were being developed in 1927.

Holland.—The development of a large super-power scheme for the Netherlands was rendered difficult through purely natural conditions: the country did not lend itself easily to the erection of long-distance transmission lines, and developments were confined to the areas of densest population. In 1927 the output of electricity for the whole territory could be estimated at 1,100,000,000 units, with a total capital expenditure of less than £30,000,000. Central Holland had already, in 1927, a main transmission system operating at 50,000 volts, more than 120 miles in length, with extensions in the vicinity of Amsterdam, Nijmegen, Arnhem, and the State coal-mines in Limburg. All these areas were due to be interlinked by overhead transmission lines of 50,000 volts and, ultimately, of 100,000 volts. Outside of this main transmission system, the country was parcelled out into areas corresponding to the provinces, with transmission networks of 10,000 volts.

Other European Countries.—In Sweden, as in Germany, the State itself played an important part in the administration of electricity supply. Out of a 1927 output of 4,350,000,000 units, State-owned power stations accounted for 1,400,000,000 units or slightly less than one-third. Six large water-power stations, interconnected by lines operating at 110,000 volts, at Trollhättam, Aelkvarleby, Motala, Porjus, Lill Edet and Nouroura, in addition to a steam generating station at Västeras, accounted for this total. The State system was connected at certain points with those administered by private companies and municipalities, but the initiative in creating the super-power zone lay with the former. The public supply of electricity proper represented rather less than half of the total annual output, while the electro-chemical, electro-metallurgical, paper and cellulose industries accounted for the greater part of the demand. The private companies operating in these industries generally possessed water-power stations interconnected for exchange of energy and for the development of a power reserve which would be available in the event of interruption in supply.

In other countries, notably Poland, Rumania, Hungary and Greece, electrical development had been held up, owing purely to political and financial factors, but, in 1927, strong power finance groups, using British, American or Belgian capital, were constructing large power stations and main transmission lines in all four countries. It was estimated at that time that, within ten years, super-power schemes would be in operation similar in character and efficiency to those in other European countries.

(H. Q.)

Russia.—The Government of the U.S.S.R. has given much attention on the development of the electrical industry. The figure of output in 1913 (in the territory of the present Soviet republics) was 1,945 million kw. and in the financial year 1926–27, 4,100 million kw. The National (or Central) Electrification Scheme includes (a) large district stations, (b) small local stations (often attached to factories) for which grants-in-aid have been given to the local authorities by the Central Authorities who retain control. The programme of the State Electrification Commission falls into three parts:—

Part I. Arrangements for the maximum utilization of existing stations.

Part II. Plans for the erection within 10–15 years of 30 district stations of total output capacity of 1,500,000 kw.

Part III. Supplies to areas requiring only small ad hoc stations.

Part I. was fulfilled in 1925. Work under Part II. was begun in 1922, when eight district electric stations were started viz.

Volk... ... e ...a ... 000 s g wa er powe
Zem ...a ... 000
s ... 0.0 ..
T e R ... n. Leningrad. . 20.000 .. using peat as fuel
Nizhni Novgorod . . 20.000 ..
The Nashira near Moscow . . 12,000 .. using coal
Shterov in Donetz basin . . 20,000 .. .. anthracite dust
Kiselov in the Urals . . . 6,000 .. using brown coal.

In 1926 the construction of the following district stations with coal as fuel was begun:

Chuguev (near Kharkov), 44,000 kw.
Shakhtinsk (S.E. Donetz basin: using anthracite dust.
Kiev 22,000 kw. and Saratov 11,000 kw.

The progress aimed at by the State Planning Commission can be judged by the following table of district stations:

Station	Power in kilowatts		
	1927	1928	1929
Shatura	48,000	92,000	136,000
Kashira	12,000	34,000	78,000
Bulakhan	20,000	64,000	86,000
Red October	20,000	65,000	110,000
Shterov	20,000	42,000	64,000
Kiselov	6,000	28,000	28,000
Chuguev	..	22,000	44,000
Artemovsk	..	22,000	44,000
Total . .	126,000	369,000	590,000

In 1927 the construction of a third group of 11 stations was initiated:

Five hydro-electric stations.—

Dnieper works: 105,000 kw. to be extended to full capacity, 220,000 kw.
Svirsk, 80,000 kw.
Gizeldon (near Vladikavkas), 21,000 kw.
Rionsk (near Kutais), 21,000 kw. (which together with Zemo Achalsk station will help to feed the Trans-Caucasian Railway).
Dzoraget (Armenia), 22,000 kw.

Of the remaining six stations of this series, three using peat for fuel, have been started at Ivanovo-Voznesensk, 44,000 kw., Bryansk, 22,000 kw.; and Osinovsk in the White Russian Republic, 22,000 kw. A further station has been erected at Chelyabinsk in the Urals, 44,000 kw. burning brown coal, and two others are in process of construction at Novorossisk, 22,000 kw., and Krasnodar 11,000 kw., both to use oil fuel. Additionally, stations at Moscow, Leningrad and Baku are being extended.

The capacity of district stations was by the end of 1927 increased to 500,000 kw., as compared with 1916 figures of 245,000 kw. In fact the plans of the State Electrification Commission are being fulfilled to the extent of 92% and the total programme, it is estimated, will be completed within the specified ten years.

The output of the electrical industry of Russia before the war amounted to about 65 to 68 million roubles; in 1926–27 it was 142 million roubles, and in 1927–28 it is estimated to reach the figure of 200 million roubles. With the centralization of supply, the cost of production has been reduced, the cost of electric current in 1927 being 17% lower than pre-war. (X.)

SCHEMES IN NORTH AMERICA: (1) CANADA

In Canada electrical power development has taken the form of the utilization of large water-power resources. The main transmission systems are to be found in Quebec and Ontario, where three undertakings, the Hydro-Electric Power Commission of Ontario, the Shawinigan Water and Power company, and the Montreal Light, Heat and Power company, have been instrumental in developing super-power zones. The total production of electricity in Canada in 1927 amounted to 12,093,000,000 units from plant with a total installed capacity of 2,820,000 h.p.

The Hydro-Electric Power Commission of Ontario, with a total capacity of generating plant amounting to almost 800,000 kw., had a total output, including purchased energy, of 4,134,000,000 units. The Shawinigan Water and Power company, with a total installed capacity of 411,350 kw., had a corresponding output of 3,021,000,000 units; and the Montreal Light, Heat and Power company, with a total plant capacity of 220,000 kw., accounted for 1,355,000,000 units. In addition, the Dominion Power and Transmission company, with a total output in 1927 of 254,000,000 units, has been active in Ontario. The total capacity of all water-power plant in the Province of Ontario alone was in excess of 1,200,000 kw. at the end of 1927.

The super-power zone served by the Hydro-Electric Commission of Ontario stretches from the outskirts of Montreal to Detroit with extensions north to Port Elgin and Huntsville. The core of the system is to be found in the area lying between Toronto and Detroit; main transmission lines operating at 110,000 volts go north from Niagara Falls to Toronto, round the shores of Lake Ontario, branch off towards Guelph, go due east to London, St Thomas and Detroit, where they link up with the system operated by the Detroit Edison company. At Niagara Falls there is interconnection with the system operated by the Buffalo, Niagara and Eastern Power group of companies, so that Lake Ontario is surrounded north and south by a ring of power lines

Further east, in the province of Quebec, the Shawinigan Water and Power company has constructed 100,000 volts transmission lines to link up the power-houses on the St. Lawrence river with the main centre of demand in Montreal. From the Shawinigan falls, lines operating at from 50,000 to 60,000 volts go north to Quebec and St. Joachim, where they link up with the system of the Laurentian Power company. From the same falls lines operating at similar voltages go due south to Sherbrooke, and form a power system touching on the American Frontier.

The Montreal Light, Heat and Power company owns the system linking up almost completely the two main systems operating in Quebec and Ontario, so that the eastern part of Canada now constitutes one of the most powerful super-power zones in the world.

Further west, similar self-contained areas have been created round Winnipeg by the City of Winnipeg and the Winnipeg Electric company working in co-operation. These two undertakings between them produced in 1927 over 860,000,000 units. Further west still, in British Columbia, a number of undertakings, chief among them the West Kootenay Power company and the British Columbia Electric Railway company with an aggregate output of 708,000,000 units, have also mapped out large high-pressure transmission zones. (H. Q.)

(2) UNITED STATES

In the United States, the development of regional schemes for the service of electricity supply has proceeded with great rapidity until, at the present time, electric current is available in all communities throughout the more densely inhabited portions of the country. The evolution of this service has taken place along lines which have largely been dictated by the economies made possible by the progressive improvements in the technical aspects of the art of the production and distribution of electric energy, as well as by further economies inherent in the organization of business enterprise upon a very large scale.

During the early years immediately following the successful demonstration by Thomas A. Edison and others of the practicability of the generation of electricity and of its delivery to consumers, electric service was confined to small portions of the larger cities. Because it could not be transported to any material distance, electricity had to be produced in the immediate neighbourhood of its consumption. This resulted in the erection of a large number of small, isolated power-houses, conducted by enterprises essentially local in character and usually independent of each other. These earlier years marked an era of competition between struggling and often antagonistic groups, with the usual result of impaired service and occasional financial distress among the undertakings. By the year 1900, however, the practicability of the commercial transmission of electricity to points at considerable distances had been conclusively proved and, since then, the voltages (or pressures) at which electricity can be transported have steadily increased. As a result the radius of transmission has been

propo ona ely engthened The ransfer o e ectric power n large q an tie o er d s ances o oo m or more be ame an operating actuah y in 19 o and ths, in turn, has effected wide-spread and fundamental changes in the organization of the service and in the economics of the schemes of regional supply.

The successful delivery of energy at points remote from its source of supply made possible the abandonment of many of the smaller power-producing plants and their replacement by larger units located at strategic points. It also made possible the utilization of water-powers located at considerable distances from the cities where the power was to be used. This era marked the disappearance of the little, isolated steam-using plants of the former period, the consolidation of many of the numerous competitive urban undertakings into single enterprises, and the inception of a large number of hydro-electric projects in those regions of the country where water-power was available. It was attended by a rapid growth in the size of the power-producing plants and by a corresponding increase in efficiency. As a corollary, it also made possible the production and distribution of electricity at lower costs (and therefore at reduced tariffs) which, again, was attended by a corresponding increase in use because of its added attractiveness to the consuming public.

With the established proof of the economies inherent in production on a very large scale, it soon became apparent that the next step lay in the further extension of transmission and in the additional concentration of production in still larger units. Further progress in the development of regional schemes, therefore, resulted in the inter-linkage of neighbouring enterprises and in the tying together of many different power-producing sources. This concept, known as the "interconnection" of electric service enterprises, has resulted in the evolution of systems of great size and has had a profound effect upon the organization and financial structure of most of the large regional undertakings of the United States For the proper consideration of the several large enterprises which furnish the bulk of the country's electric service, further mention must be made of the fundamental advantages of the interconnection of electric power supplies and their place in the industrial structure of the United States. In brief, the tying together of separate sources of power under a scheme of unified operation produces:—

(*a*) A marked lowering of the cost of producing power, largely because the great bulk of the energy can be generated in very large plants located at exceptionally favourable central points and distributed in all directions over the several systems.

(*b*) An increased reliability of service, because the failure of one power-plant, through some mishap, will not extinguish the flow of energy to the consumer. Any of the other plants connected to the lines can immediately step in and make up the deficiency. In many sections of the country this is a matter of great import. Many of the water-power plants have been constructed along rivers of remarkable fluctuations of flow and in regions of intermittent (though occasionally heavy) rainfall. A deficiency of water supply, while it may cause the temporary shut-down of such a plant, will not cripple the lines of interconnected systems where other power-houses are available to carry the load. In many cases, where a territory of wide extent is covered, it has been found advantageous to install water-power plants upon different rivers. On these, the increased stream flow from one drainage area will often offset a diminished flow from others. There are several outstanding examples of the successful application of this theory, where power has been relayed from one system to its neighbour and deficiencies in one section of the territory has been remedied by aid from others. In recent years, this has enabled many manufacturing establishments to continue operations when, in times of severe drought, local utilities would otherwise have been faced with drastic curtailment.

(*c*) Again, where a wide area is served, it is often found that the maximum electrical requirements of the various consumers come at different times of the day in different cities. Where they can be served by one unified system, a marked improvement in the continuity of the operation of the power-plant machinery can be effected. A notable example of this is the daily diversity of e ectrica demand be.ween the manufacturing city of Wilmington Del., with its daytime industrial load, and the neighbouring seaside city of Atlantic City, N.J., with its great blaze of nightly lighting.

These regional schemes of long distance transmission have had a notable effect upon the general industrial development of the country, inasmuch as they have made possible the location of factories at economic points dictated by markets and materials, with the guarantee of sufficient power no matter where located. Power supply for factory operation has thus become generally available over wide areas, and industry has been relieved of the necessity of locating factories at the point of power generation and has been free to consider other factors. The results of the expansion of these regional schemes are evident in the progressive electrification of industry. At present, 50% of all factory machinery operates on power procured from public service enterprises; the ratio was 44·4% in 1925, 17·4% in 1914, and but 3·3% in 1904.

Typical Regional Schemes.—The United States of America cover an area which is continental in extent. Within its borders are found geographic and topographic features of every description, accompanied by climatic, industrial and social conditions of all types. Each of these has had its effect upon the character and magnitude of the regional electrical schemes serving that particular territory and has accordingly produced systems of various sizes and degrees of complexity. Of these, the more important are located as follows:—

In *New England*, with its compact population and its numerous large industrial cities, the service of electrical supply is carried on mainly by local enterprises serving their own immediate neighbourhood. The larger plants are situated along the sea-coast, where electricity is generated by steam dependent, for the most part, upon fuel-oil or coal transported by water. An interconnected system, however, has been established in a generally east-and-west direction through the middle of Massachusetts, with branches extending southward into Connecticut and northward to the large water-power plants of the upper valley of the Connecticut river, and with the Edgar Steam Plant of the Edison Illuminating Company of Boston as the eastern terminus of a trunk line extending westward through New York State to Niagara Falls.

In *New York State* the regional supply schemes roughly follow the great economic divisions of the State. The metropolitan district of New York city and its suburbs is industrially, socially and electrically unique. Power is produced entirely by steam, in many power-plants of enormous extent and representing, in all probability, a greater concentration of energy than is found in any other area of similar size throughout the world. The electric enterprises within the city, while they are all connected with each other, comprise a self-contained area and are not interconnected with any of the others serving the adjacent territory. The western end of the State, embracing the territory lying between the Canadian frontier and the city of Syracuse, some 200 m. east, is largely dependent upon the water-power of Niagara falls and the bulk of its industries comprise the heavy manufacturing and chemical plants which the availability of this great supply of remarkably cheap power has fostered. This territory is served by the Buffalo, Niagara and Eastern Power Corporation, which procures some 430,000 h.p. of hydro-electric energy from its plants on the American side of Niagara, together with large (but fluctuating) amounts of power from its plant on the Canadian side and from the power-houses of the Hydro-Electric Power Commission of Ontario in Canada. Owing to the restrictions of the international treaty entered into between the United States and Great Britain to limit the amount of water diverted from the Niagara river above the falls, Niagara does not yield a sufficient amount of energy to meet the demands of the territory served and a steam-using power-plant of great size has been built almost within sound of the falls to make up the deficiency. All these plants are interconnected, through transmission lines beyond Syracuse, with those of the New York Power and Light Corporation to the east and these, in turn, with the main trunk line through Massachusetts to Boston. Other lines run south into the Pittsburgh region of Pennsylvania and north-easterly into Quebec where they te in wi h

those of the Montreal Light, Heat and Power Company.

In the *South* there has been developed a regional scheme of great magnitude. This takes advantage of the varied water-powers of the rivers of the Blue Ridge, or southern extension of the Alleghany mountains, supported by fuel-burning plants situated in the heart of the several coal-fields. Beginning at the Government hydro-electric plant at Muscle Shoals on the Tennessee river, the lines of the Alabama Power Company run south-eastward, past the Sheffield and Warrior steam-plants, through the centre of the iron and steel district of Birmingham. Beyond this, they are reinforced by large hydro-electric plants located on the Coosa and Tallapoosa rivers (the Martin dam of 180,000 h.p., the Mitchell dam of 130,000 h.p., Lock Twelve dam of 110,000 h.p., Lock Eighteen dam of 216,000 h.p., still under construction) and at the Georgia State line they connect with those of Columbus Electric and Power Company (leading southward into Florida) and with those of the Georgia Power Company. Passing eastward through the territory of the latter company, these lines connect on the north with those of the Tennessee Electric Power Company (whose operations include large hydro-electric plants at Hales Bar and others along the upper Tennessee) and with the Georgia company's water-power plants on the Tallulah and Tugalo rivers. At the South Carolina boundary the lines are interconnected with those of the Duke Power Company, which serves the larger part of the States of North and South Carolina and operates hydro-electric plants on the Broad and Wateree rivers. In the eastern part of North Carolina the Duke Power Company connects with the system of the Carolina Power and Light Company, which, in turn, is tied into a great trunk line leading north-westward through the western tip of Virginia, through West Virginia, etc., to the industrial region of Ohio and western Pennsylvania and served by many large fuel-burning plants located in the heart of the more northerly coal-fields. The presence on this regional scheme of the many and varied water-powers, extending over a mountain area some 300 m. long, and the support of the coal-burning plants interspersed throughout the system, has made possible the furnishing of great volumes of continuous power at comparatively low tariffs and has thus aided to a large extent in the attraction of much industry into this region during recent years.

In the *Chicago district* the regional scheme of electricity supply has taken the form of a ring of high-tension transmission lines around the city, with the installation of large steam-using plants within the city itself and at strategic points to the north, east and south-west of the ring. The close proximity of this region to the large Illinois coal-fields to the south has resulted in the establishment of an industrial zone of great importance throughout this area, in which the manufacture of iron and steel products predominate and which, in turn, has resulted in the demand for great volumes of electric energy. In this district are to be found the largest of the power-plants of the country (Waukegan, 350,000 h.p., Crawford avenue, 434,320 h.p., Powerton, 500,000 h.p., under construction; State Line, 1,000,000 h.p., under construction). The three great plants at the extremities of the ring are in turn, interconnected with trunk transmission lines tying-in to other systems. Waukegan, to the north, is linked with the lines leading through Milwaukee to the hydro-electric plants of northern Wisconsin. Powerton, to the south-west, connects with lines traversing the Illinois coal-fields and reaching the City of St. Louis. State Line, to the east, constitutes the western terminus of a trunk-line passing eastward across northern Indiana, through Ohio and connecting with the Pittsburgh industrial district to the east and with the southern regional scheme (already described) to the south-east.

On the *Pacific Coast*, the regional schemes have largely taken the form of diverse hydro-electric developments through the mountainous areas, with transmission lines to bring this energy into the populous districts bordering the ocean. The topographical characteristics of this territory embrace, primarily, a comparatively narrow coastal plain, beyond which numerous ranges of high, snow-capped mountains parallel the sea. The water-power plants are essentially those utilizing a high "head" (or fall) with a comparatively small amount of water and are admirably suited to a régime where the annual precipitation of moisture is relatively small and located, for the most part, at high altitudes. In the North-west the lines of the Montana Power Company utilize the water-powers of the upper Missouri and, after supplying the copper smelters of Anaconda and Silver Bow, lead westward across the northern tip of the State of Idaho. Here they connect with those of the Washington Water Power Company, operating in the flat country of the Columbia Basin and, in turn, connecting to the west with those of the Puget Sound Power and Light Company. The water-powers of this enterprise are located on the western slopes of the Cascade mountains and tie-in, to the north, with those of the Western Power Company of Canada, similarly located in British Columbia. Turning south, the general scheme of supply parallels the Pacific ocean as far as the Mexican boundary. In California, this type of high-head power supply has reached a state of intensive development. The Pacific Gas and Electric Company operated in 1927 some 32 hydro-electric plants of various types and sizes, with a total capacity of some 630,000 h.p., and supported by three steam-plants with a total capacity of 180,000 h.p., located at tidewater and burning the fuel oil which the southern part of the State has developed in great quantities. Interconnected to the north are the lines of the California-Oregon Power Company (which, again, tie-in with other enterprises and eventually reach those of the Puget Sound Company mentioned above) and, to the south those of the Great Western Power Company and the San Joaquin Light and Power Corporation, both operating water-power plants of the same general type. The San Joaquin enterprise is, again, in contact on the south with the properties of the Southern California Edison Company. This organization operates the largest individual water-power plants in the West. At the end of 1927 it had in service some 20 hydro-electric plants with a total capacity of 475,000 horse-power. In this connection, however, the changing relationship between the cost of steam-power and hydro-electric energy is well illustrated by the fact that this enterprise is finding it more economical to install fuel-burning plants at tidewater, at the centre of the market, rather than to bring in electricity over long transmission lines from the High Sierras at least 200 m. away. The Long Beach steam-plant of this company contained, early in 1928, 400,000 h.p., operated on the fuel-oil and natural gas produced practically at the doors of the plant.

BIBLIOGRAPHY.—For interconnection in general, with maps, see *The Annalist* (May 14, 1926 and June 1, 1928) and *Bulletin of the National Electric Light Association* (July 1928); New England, *The Annalist* (June 11, 1926 and July 20, 1928); Middle Atlantic States, *ibid.* (July 16, 1926). Both of these are also treated in the *Report of the North-East Super-Power Committee* (May 1924). The Pittsburgh-Ohio area, *The Annalist* (Sept. 17, 1926); the South, *ibid.* (Oct. 15, 1926); the Chicago-Detroit-St. Louis Area, *ibid.* (Dec. 17, 1926). Details of the growth of the industry, with statistical exhibits, are found in the *Handbook of the National Electric Light Association*, published annually.

(W. M. CA.)

ELECTRICAL POWER GENERATION is accomplished almost entirely in two ways; utilization of power obtained from burning fuel, generally for steam generation, and the utilization of natural and created sources of water-power for hydro-electric generation.

I. GENERATION FROM FUEL

The term electric power applies to a continuous supply of electric current through wires from central generating points in quantities sufficient for the operation of motors, heaters, lights and equipment for doing work electrically. This power may be in the form of direct current, *i.e.*, that which flows always in the same direction around the circuit, or in the form of alternating current, which rapidly reverses in direction of flow. Each has its special uses in industry, in homes and on the farm. The generating points of electric power are termed power plants, generating stations or central stations, and are commonly located in large cities or at other points close to large centres of use. The power requirements which they satisfy are termed the "load." In the generation of electric power from fuel, the heat energy of the fuel is first converted into mechanical power by a prime and then into electrical power or current by a generator. The

prim pa pr re movers n use n 928 are ne s eam turb ne a d he F draulic tu b ne s e TURB NE WATER). In isolated plan of mall capacity, and in marine plants, primary power is often derived from oil and gas engines, and it is possible to obtain it from various other prime movers such as windmills, tide machines, etc., although these latter are inefficient and cumbersome and therefore seldom used.

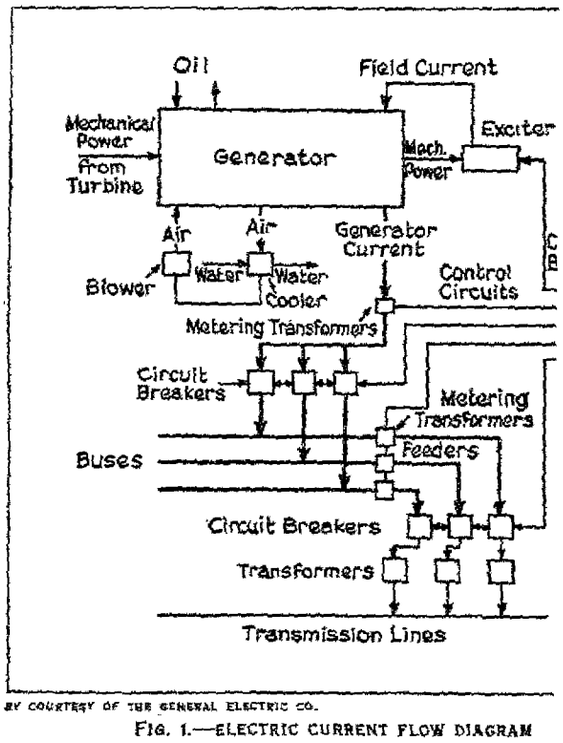
Development.—In the United States the steam turbine generates about 60% of the total electric power, while most of the remainder is derived from water-power (*see* below under "Hydro-electric Generation"). In other countries the ratio is different, depending upon the available supply of commercially useful hydraulic energy and upon relative fuel costs. In the early steam station reciprocating engines were used exclusively, and the power was generated by direct-current dynamos. At about 10,000 h.p. both the reciprocating steam engine and the direct-current machine reached their practical limit of size, and a serious question arose as to how the output could be increased at reasonable cost. Engineers then turned their attention to the steam turbine, which Parsons in England had used successfully in 1897 to drive a British naval destroyer. In 1903 a Curtis turbine was installed at the plant of the Chicago Edison Company and there successfully drove a generator of 5,000 kilowatts (6,700 h.p.) capacity. The problem of greatly increased power in less space was thus solved by the turbine, which was even then as efficient as the reciprocating engine. The use of alternating current, also, made possible the economical transmission of power over considerable distance, thus bringing electric service to communities far from the generating point. Since 1903 both turbines and generators have been greatly improved in design, until to-day single units of 280,000 horsepower are practicable and are being built. (*See* ELECTRIC GENERATOR.) In general no limit to capacity can be set. Economic considerations lead to generating units of very large capacity, few in number, rather than to many small machines, but in each case the local conditions determine just how large a single machine should be. Every central generating station is an individual case, and its design depends upon local conditions, such as amount and character of land available, kind of fuel, source of condenser cooling water, and the kind of electrical load served. In addition to steam generating equipment (*see* STEAM GENERATION, BOILERS), stations are structurally divided into (a) generating room, (b) bus structure, (c) switching and transformer equipment, and (d) control room. These elements will be discussed in the following paragraphs, after which a description of an actual modern central station will be given in order to illustrate the principles involved.

Generating Room.—The generating room runs the full length of the station, and is comparatively narrow (*see* Pl. I., fig. 3). The turbine-generator units are installed side by side with considerable space between them, and are completely enclosed in steel casings. A travelling crane, resting on heavy I-beams, gives a lift of 50 ft. or more, so that the casings and rotating parts of the units may be lifted clear for repairs. Often the end walls of the room are of steel-sashed glass and occasionally the entire roof is made a skylight to bring full daylight into the room. There is a note of clean simplicity about the place which is far removed from the usual suggestion of griminess and complication which clings to machinery. The turbines are fed by heavily heat-insulated steam pipes, which come through from the boiler room. The electrical output of the generators is carried to the bus room by cables placed in ducts beneath the floor of the room. In most instances there is little other equipment on the generating room floor besides the main units, although in some cases small separate turbine-generating sets are installed there to supply current for station auxiliaries and lighting circuits. Directly beneath the generating room the condenser well is located, the condensers themselves being bolted directly to the under sides of the turbines or connected to them by flexible joints, although in many stations this well is part of the main room, the turbine units are installed on platforms built above the condensers. The well usually contains the circulating pumps, air and hot-well pumps, and feed water heaters, together with the air-cooling system for the generators. Boiler feed pumps and e apora o r. placed between the condenser w boiler room.

Bus Structure.—The bus structure is composed of he conductors supported on insulators and installed in con It is the concentration point for all generated power, f it is drawn by branch lines called feeders, going to t points of use. Practice differs widely as to the numb rangement of the buses, but the principle is that of p output of several machines so as to give the greates Each generator is provided with several oil switches it may be connected to any bus desired. During its pa the generators through the buses the current is passe small transformers which are connected to groups of m control room. In this way the output is measured wit ruption or change in magnitude.

Switching and Transformer Equipment.—If the supplying nearby load the feeders will pass directly fr structure to the pole lines or underground cable ducts electrical service at generated pressure. Groups of sw used to connect the feeders to one bus or another for nomical operation according to load. If the station outp transmitted to distant load centers, the electrical pressu raised in order that the reduced currents which result, a smaller resistance loss. As the pressure is increase rent is proportionally reduced for the same power. Th the use of smaller conductors and at the same time cc losses, with consequent saving both in construction and costs. To effect this raise in pressure (voltage) large p formers are used, and these may be connected between and buses, or between buses and feeders. For this type switching is usually done between transformers and tr lines by high-voltage oil circuit breakers.

Switching and transforming equipment is often ins



BY COURTESY OF THE GENERAL ELECTRIC CO.

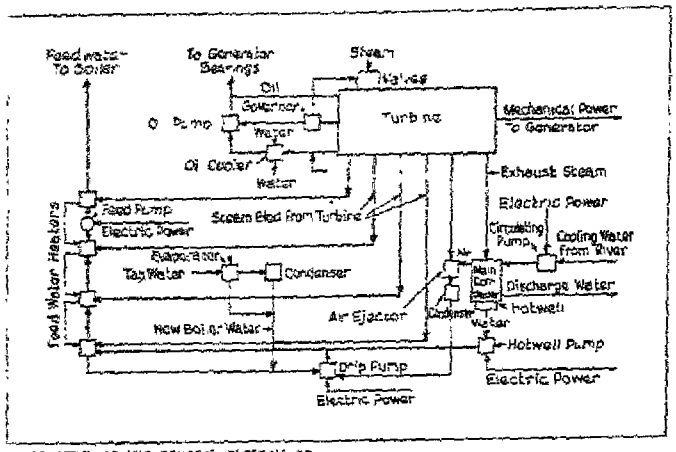
FIG. 1.—ELECTRIC CURRENT FLOW DIAGRAM

doors and is designed to withstand any weather conditio in congested districts, such as New York City, usually switchhouses, feeding into underground cables.

Control Room.—This is the operating headquarters tion. Here the meters and instruments which indicate the electrical flow in all circuits are mounted on an easi switchboard, and here are located the switches for the circuit breakers, and the lamps which indicate t ator the condition of every piece of apparatus. By me buttons and telephones orders are transmitted from

room to the boiler and generating rooms, so that the attendants may be instructed to carry out the operations not included in switching. In some stations there is no control room as such, the meters and control switches being located on vertical boards placed in a gallery above the generating room.

The progress of power through the station then, is briefly as follows (*see* Flow Diagram): Steam flows to the turbines, gen-



BY COURTESY OF THE GENERAL ELECTRIC CO

FIG. 2.—STEAM FLOW DIAGRAM

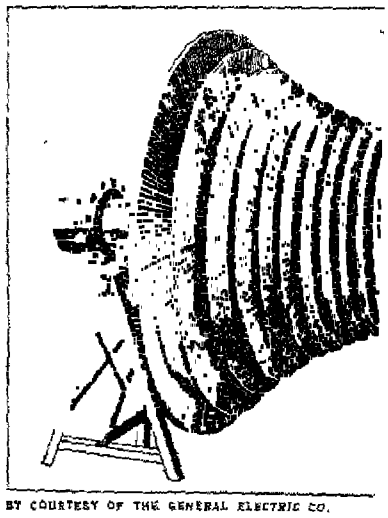
erates rotating power, is exhausted into the condensers and is returned as water to the boilers. The generators change the rotating power to electric current, which is measured, concentrated on buses, and switched to the proper circuits. These circuits either distribute directly to nearby loads, or carry the currents to transformers which *step up* the voltage for transmission to distant points. Control and supervision of all station operations is centred in one room.

Steam Flow Through the Station.—In general principle the turbine (*see* STEAM TURBINE) is a highly efficient windmill. Steam issuing at high velocity from nozzles impinges upon the blades or buckets on the turbine wheels, thus causing the latter to revolve. In order to gain the greatest efficiency the speed of the buckets must be a definite fraction of the speed of the steam. To utilize this velocity on a single bucket wheel would require bucket speeds beyond the strength of materials available. Therefore the steam is expanded in stages, through successive sets of nozzles, each of which transforms part of the steam pressure into a moderate velocity. This velocity is then absorbed by a bucket wheel, and the steam goes on to the next set of nozzles and the next wheel. This arrangement is called pressure staging and it permits the many rows of buckets on the turbine wheels to absorb the steam's energy at high efficiency. The expansion of the steam cools it and reduces its pressure. When all of the recoverable energy has been extracted, the steam is released into the condenser and is changed back to water for return to the boiler. The steam entering the turbine is at a high pressure, and occupies a small space, so that the first stage blades may be no more than $\frac{3}{4}$ in. long. In doing its work upon the blades the steam expands as it does in the cylinder of a steam engine. Thus each successive stage has larger blades than the last, and at the exhaust end of the turbine the blades may be two ft. or more long (*see* fig. 3). The blades are arranged radially upon the circumferences of wheels fastened to the turbine shaft and these wheels increase in overall diameter in the big machines from perhaps 4 ft. up to 11 ft. or more. The steam pressure at the start may be from 300 to 600 lb. per sq.in., and several installations are using pressures as high as 1,200 pounds. The initial temperature in most recent installations is 700° or above, this limit being set by the physical properties of present-day metals and alloys. About 200° of this is superheat above the boiling temperature at the pressure used. Superheat is important because of the much higher efficiency of the heat cycle and because more stages of the turbine can then operate on dry steam. The exhaust from the turbine is of large volume when it enters the condenser. Contact with the cold surface there subtracts just enough heat units to change the steam its actual temperature appreciably 400 to 1 reduction in volume, and a condenser which is of the order of $\frac{1}{2}$ l vacuum is usually expressed in inche metric column, 28 to 29 in. being t turbines. The 13 lb. drop below atmo makes it possible to obtain almost t steam than in a non-condensing insta which holds the circular rows of stat cross-section and somewhat conical in tapering construction of the rotor through the length of the turbine and bearings. One end of the turbine sh of the generator shaft. Since one e high pressure and the other under h are necessary around the shaft to red addition, a series of circular ribs on t engages with similar ribs in the casin little steam leaking through this is t at about atmospheric pressure. A w the atmospheric side to prevent ste water seal on the exhaust end prever condenser.

The Condenser.—The condenser c tion of the boiler, reducing steam to of a large number of parallel bronze casing. Cold water is pumped through steam is condensed against their outs tom of the casing into a chamber c is pumped back to the boiler

Steam Auxiliaries.—In addition to there are various auxiliaries necess operation. They are, chiefly: (a) Ste turbine governor, (c) bearing oil sy culating pump, (f) hot-well pump, drip pumps, (i) feed-water heaters various elements will be taken up in

Strainers and Valves.—A metal s steam supply pipe to catch foreign r system. The steam then passes thro

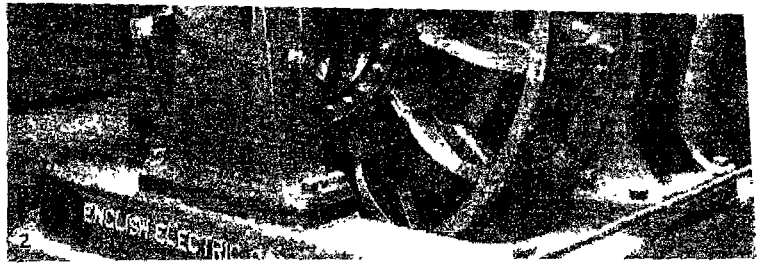


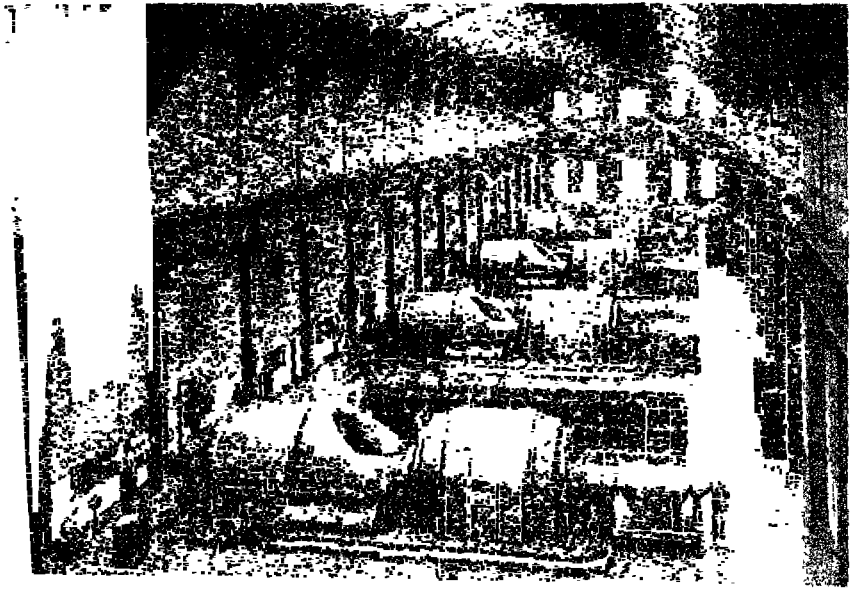
BY COURTESY OF THE GENERAL ELECTRIC CO.

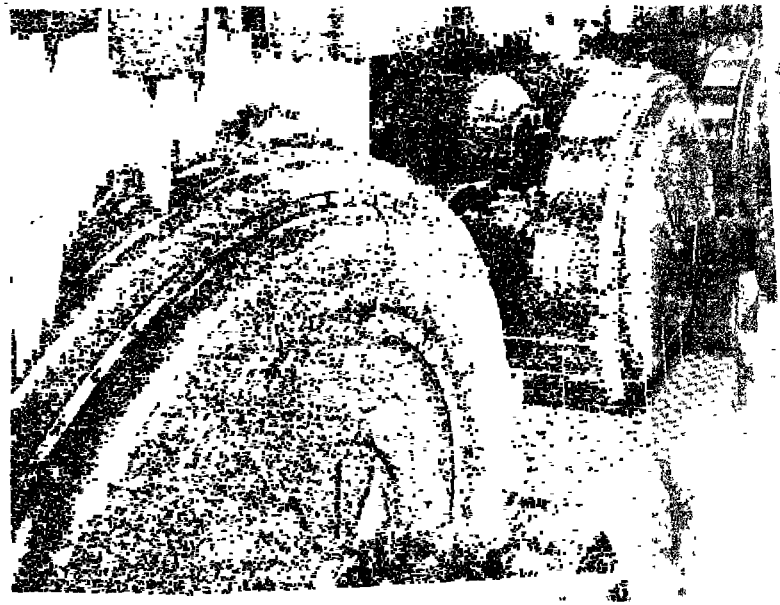
FIG. 3.—SEVENTEEN STAGE ROTOR

valve into the turbine. This val stopping only.

Governor.—It is necessary to l the turbine with an amount of ste to carry the desired amount of loa and operates, through a hydraulic mitting steam to the turbine nozzl to admit more or less steam, the faster or slower than standard sp speed by its generator which will smaller share of the electric loa







Bearing Oil System.—Turbine bearings are of the cylindrical type and are lubricated and cooled by oil which is forced through them by a pump geared to the turbine shaft. A separate steam-driven pump is usually employed during the starting up period. To dispose of the heat in the oil, coolers are provided in which water is made to circulate, the heat sometimes being delivered later to the feed-water system. A large oil reservoir is usually built into the base of the turbine.

Condenser Pumps.—In the design of the modern power station the matter of a plentiful supply of cooling water for the condensers is of prime importance. It is necessary to locate the station close to a river, harbour or lake, because the quantity of water needed is very large. In the big stations, as for instance the Richmond Station in Philadelphia, where the installed capacity is 160,000 h.p., a flow of condenser water of about 160,000 gal. per min. is required. This water can be used only once since it becomes ineffectual as a cooling medium as soon as its temperature has been raised by passing through the condenser. It is therefore pumped through the system and then discharged into the river. Centrifugal pumps are employed for circulating the cooling water, and these are driven by electric motors or small steam turbines. Each condenser has its own pumps, usually in duplicate, so that an accident to one pump will not rob the condenser of water and thus force the turbine to be shut down, because of lowered efficiency. Turbines are provided with atmospheric exhaust valves, but these are used only to avoid blowing up the machine in cases of condenser failure. The cooling water circulates through the bronze tubes of the condenser where it receives the heat from the steam and leaves the condenser about 15° higher in temperature than on entering. In regions where there is wide variation between summer and winter temperatures and consequent warm cooling water supply in summer, the vacuum will be reduced and the turbine efficiency cut down. An ejector or vacuum pump is connected to the condenser to remove air and other gases which do not condense and which tend to destroy the vacuum. These gases have either leaked into the turbine through the packing glands, or else have come through with the steam from the boiler. A hot well or sump is located at the bottom of the condenser to catch the water. A pump is placed here to start the water on its journey back to the boiler. There may also be other pumps in connection with certain steam auxiliaries, as for instance the drip pumps, which take the condensed steam from the feed-water heaters and evaporators and return it to the hot well or feed-water line.

Feed-water Heaters.—The simplest steam power cycle passes the steam through the turbine and exhausts it into the air, an inefficient method which uses less than 10% of the heat energy in the steam. By adding a condenser and returning the water to the boiler the efficiency of the cycle can be doubled. But there is still a large quantity of heat lost in the condenser to the cooling water. It is possible to capture some of this heat before it reaches the condenser by extracting a certain quantity of steam from the turbine at various stages of its expansion and while it yet contains considerable heat energy. This extracted steam is used to heat the boiler feed-water. The principle of interstage feed-water heating is that of using the heat energy of the steam at high temperatures rather than of allowing it to escape into the condenser where the temperature is so low that feed-water heating cannot be accomplished. The boiling point of water rises with a rise in pressure and for this reason the temperature of the boiler feed-water can be very much higher than the atmospheric boiling point (212°). The water coming from the hot well of the condenser is usually between 70° and 100° F and may be heated to 300° or 400° before entering the boiler. The process is carried out in heaters consisting of casings containing nests of pipes surrounded by steam extracted from the turbine. It is common practice to have several heaters in series, each one contributing perhaps 50° to 100° to the temperature of the feed water. The steam used in these heaters must be hotter than the water heated, and the feed-water progresses from heaters of lower temperature to those of higher. The supply for each heater is therefore taken from the turbine at a point where the steam ture exists. By careful calculation it is possible to determine an arrangement of heaters which will give the maximum use of the heat sent into the turbine in the steam. The number of heaters ranges from one to five, and the steam they use may be as much as 25% of the total supplied to the turbine. The heating steam condenses in each heater and goes to the heater unit of the next lower temperature, and finally to the drip pump and into the feed-water line.

Feed Pumps.—The water is forced into the boilers by feed pumps located somewhere along the line between the hot well and the boiler. These pumps are usually of the centrifugal type driven by electric motors or by steam turbines.

Evaporators and De-aerators.—There is, inevitably, a slight loss of feed water from the system. This loss may be made up by pure water supplied by evaporators. These are stills heated by steam drawn from the turbine. Raw water is evaporated in them and passed to a small condenser whence it is discharged into the feed water line. A small amount of dissolved air is also carried out of the condenser by the water, and may be removed by a de-aerator before it reaches the boiler. (For a fuller description of these boiler auxiliaries, *see* STEAM GENERATION.)

The steam apparatus commonly used in the modern generating plant is subject to many variations. In very large turbines the volume of the steam may be so great that it is sent into them at the middle, passing out at both ends. This is called the double flow turbine. Mechanical limitations may make it impossible to build a single turbine which can handle the volume of flow required for very large powers. In this case two separate turbine cylinders are used, each with its own rotor. One unit operates on high pressure and exhausts into the other. Both are on the same shaft, and drive a single generator. This is called a tandem compound machine. The largest turbine in the world, rated at 280,000 h.p., being constructed in 1928, is of the cross-compound type. It is virtually three separate turbines; a high-pressure unit receiving steam from the boiler, and sharing its exhaust between two low-pressure units. All three have separate shafts and separate generators. It is becoming the practice with compound turbines to pass the steam exhausted from the high-pressure unit through a resuperheater in the boiler, to regain the initial temperature without raising the pressure. This gives the important advantage of dry steam throughout all the turbine stages.

Electrical Flow Through the Station.—In the central station electric current is produced by a machine called a generator. Mechanical power is produced by the turbine from steam, and is used to turn the rotating member of the generator, which, by utilizing the action of magnetic forces upon coils of wire (*see* ELECTRIC GENERATORS), produces electric current which may be sent out to supply the station load.

Development.—The fundamental factor in modern electric power generation and transmission is the use of alternating current. In the early days it was thought necessary to produce and sell direct current, and for this purpose direct-current machines were built exclusively. They were large and costly because of the provision which had to be made to change the alternating current generated within the machine to uni-directional current for outside use.

During the later '80s alternating current was strongly championed by George Westinghouse who, with the aid of William Stanley, produced in 1886 a commercially practical transformer and thus opened the way to alternating-current electrical distribution. Since 1890, central station development has been along alternating-current lines, with the exception of a few installations in Europe where direct-current generation and transmission is used. For certain purposes, such as for trolley or tram cars direct current is universally employed, as also in many railroad electrifications. This current, however, is obtained by feeding alternating-current power from the central station to outlying substations, where special machines (called synchronous converters) convert it to direct current. In a number of districts the original Edison three-wire direct-current distribution system is still used, the supply being derived from substations which have large installations of storage batteries for use during severe

peak loads or when emergencies interrupt the normal supply.

The Generator.—The alternating-current generator (*see* ELECTRIC GENERATORS) operates on principles discovered about 100 years ago (*see* ELECTRICITY). A hollow cylindrical steel element, the armature or stator, contains groups of insulated copper conductors. Within this armature a cylindrical rotor is placed, called the field. The field contains a series of coils so arranged that the passage of a direct current through them produces on the surface of the rotor or field a series of magnetic north and south poles. Thus a two-pole generator has one north and one south pole, a four-pole machine, two of each kind and so on. As the rotor revolves the magnetic flux at the poles sweeps around the cylindrical inner surface of the armature, cutting the armature conductors with magnetic lines of force. Currents are generated in the conductors of the armature, depending for their magnitude, voltage and rate of change (or frequency) upon the speed of the rotor and the number of its poles. A complete alternation of current in the armature conductors is called a cycle and is obviously the result of one whole revolution of a two-pole rotor, or of one-half revolution of a four-pole rotor, etc. In order to give satisfactory service the rate of alternation or frequency of the generated current must remain essentially constant, and this is done by regulating the rotating speed by the turbine governor. Twenty-five, fifty and sixty cycles per second are the frequencies to-day.

Modern central station generators are designed to give current at the highest voltage or pressure consistent with safety of insulation. Ten to 12 thousand volts is common practice. Early generators delivered current from a single set of conductors into a single external circuit, requiring two wires. It is the modern practice to put three windings on generator armatures, so connected that there are three external wires, of which any one pair is carrying current independently. In other words, each wire belongs to two different circuits and is carrying two different currents at the same time. It is thus possible to generate and transmit about twice as much power with three wires as with two. This is called the three-phase system. Certain classes of machinery, such as converters, may employ as many as twelve phases, though the economic advantage for transmission is practically exhausted with three.

House Service Generators.—The present tendency in central station design is to drive the auxiliaries such as pumps, etc., by electric motors. Current for this purpose is provided by service generators, which are small low-voltage machines built on the main generator shafts. Thus each main unit has its service generator, so that when the turbine is running it supplies its own auxiliaries and is independent of outside sources of supply. For starting up, the auxiliary motors are connected to a current supply generated by other turbines already running, or provided from sources outside the station.

Exciters.—The direct current for the rotating field is supplied by a small generator called the exciter, which is usually built integrally with the main generator on the end of the latter's shaft. By manipulating this "exciting" current (which is relatively small and of low potential) very close control of the main generator voltage is obtained with simple equipment which is usually located in the control room.

Cooling.—The conductors in the generator are made as large in cross-section as is possible in the space available, so that they are of very low resistance. However, the flow of current through any conductor whatever causes some resistance loss, which appears as heat in the conductor. Furthermore, some heat is generated in the iron of the core by the rapid changing of the magnetic flux (*see* ELECTRICITY). This heat amounts to only about one per cent of the generator output, but is numerically large in large machines. In a 60,000 kilowatt generator, for instance, the loss might amount to 600 kilowatts—enough to run a small factory or light a whole street of private homes. The heat losses may be dissipated by placing a fan on the end of the shaft to circulate air through the spaces between armature and rotor. With large machines it is now general practice to enclose the machine entirely and to force air through it with external centrifugal blowers. A recent design returns the warmed air to a cooler known as a surface air cooler, in which water circulates in a nest of pipes similarly to the steam condenser. This permits the same air to be used over and over again, thus avoiding the large quantities of dirt likely to be brought in by new air. Still higher cooling efficiency is expected from a scheme now under development, using a single gas such as hydrogen instead of air. This is based on the fact that more heat can be absorbed by hydrogen than by an equal volume of air. Less gas therefore can be used, thus cutting down the size of blowers, coolers, etc., and reducing the friction loss occasioned as the gas passes over the surfaces to be cooled. Blowers are usually driven by electric motors, and installed in duplicate to assure dependability.

Lubrication.—The bearings of the generator are of the same self-aligning type as those of the turbine. They are lubricated and cooled by the same oil as for the turbine and are included in the same piping system.

Fire Protection.—The compounds with which the generator insulation is impregnated are somewhat inflammable, and if electric arcs are accidentally started within the machine a destructive fire may develop. There are various automatic schemes for warning the station attendant of a generator fire and for spraying water on the windings, or for replacing the circulating air by CO_2 or some other inert gas which will smother the fire. The temperature of the windings is also carefully watched upon an indicating meter on the switchboard. This meter is connected to small coils within the machine, which are carrying a steady current. A rise in temperature of the main windings changes the resistance of these coils and causes the meter to indicate it. (*See* THERMOMETRY, *Electrical resistance type.*) Temperature indicators are sometimes arranged to give audible warning of excessive heating or even to shut down the generator by automatic means when the danger point is reached.

Handling the Current.—The current from the various generators is pooled upon a conducting structure known as the bus system. There are usually several buses, so connected as to provide a star, or ring-shaped, path for the current. The generators are attached to the bus system by individual lines so arranged that in case any section of the bus becomes inoperative the generators feeding that section can be reconnected through alternative paths to the portion of the bus still in service. In the larger stations the buses are elaborately sectionalized, the sections being installed in separate fire-proof vaults. Trouble on any section is met by disconnecting that section completely, and shifting the load upon it to some other section. The buses and bus sections are connected together through oil circuit breakers, and the generators are connected to them in the same way. These circuit breakers are operated by small electric motors or solenoids, which are set in motion by switches in the control room. They are usually equipped with tripping relays which cause the breakers to open their circuits when dangerously heavy currents flow in times of accident. In many stations the feeder circuits are provided with current-limiting reactors which prevent the flow of destructive short-circuit currents and the consequent lowering of the voltage over the whole system. They have no appreciable effect upon normal power currents. Reactors are also frequently used between bus sections. A bus is composed of a group of heavy copper bars or cables rigidly supported on insulators, one conductor for each of the three phases. Modern practice is tending toward the isolated phase arrangement, in which each conductor is installed in a separate concrete room or gallery, often on a separate floor of the building from the other phases. Isolation is also sometimes effected by enclosing each bus in a grounded metal shield. These elaborate precautions are taken to avoid the spread of electrical fires starting from burnouts or short circuits, and thus to increase the reliability of the station.

Metering Transformers.—The load currents are too large and of too high a potential to allow of their being sent directly through meters. To get around this difficulty, small transformers are connected into each generator circuit and each feeder circuit, the secondary windings of which supply to the meters small low-voltage currents, which are proportional to the load current and voltages (*See* TRANSFORMERS.) These tr

are des gned to operate without consuming an apprec able amoun o po er Th current t ansformer cons ts of an ron core and ecord ry w nd ng associated with a straight heavy conductor which is part of the main circuit. The potential transformer is a miniature power transformer with a primary winding placed across a phase of the main circuit and the secondary winding feeding the meter. Both types operate on the principle of a current induced in a winding by the action of a fluctuating magnetic field.

Control Room.—The switching of the generators and feeders and the apportioning of the load among them, is managed from a central switchboard. This consists of a number of vertical panels upon which are mounted the meters and recording instruments for reading current, voltage and power. A desk (*see* Plate I. fig 3) or horizontal portion in front of the board is provided with rows of pull-button switches, which are connected through low-voltage circuits to relays on the various circuit breakers. When energized by pulling out the buttons, these relays connect the electric operating mechanisms of the breakers to a power supply circuit and open or close them as the case may be. Red and green lamps on the board are associated with each relay so that an indication is given of the condition of the breaker.

A signalling system, somewhat similar to that employed on shipboard between bridge and engine room, is installed between the control room, boiler room and generating room. If the operator wishes a generator started up he presses the proper button, which actuates a signal beside that generator. The attendant starts the machine and, when it is up to speed, the operator synchronizes it with the system with the aid of a synchronizer. When the incoming generator is "in phase" it is switched onto the desired bus. The turbine governor is then adjusted by means of remote control so that the generator will take whatever amount of load the operator wishes it to carry.

The operation of all station equipment is correlated in the control room, so that the station as a whole produces and sends out power when and where it is needed. By means of a totalizing instrument the sum of all the outgoing feeder currents is indicated on the switchboard, so that the operator can start up machines or stop them as the load-demand requires. An indication of the totalized demand is also given in the boiler room, to assist the fire-room attendants in supplying enough steam, and in anticipating changes in station output.

With the enormous quantity of energy required in the present day metropolitan area, it is usually necessary to join a number of central stations together on a single network, often backing them up by hydro-electric power sent in from a distance over transmission lines (*see* ELECTRICAL POWER TRANSMISSION). In such a system, the control room of any one station is but a subordinate point, the real control resting with the "chief load dispatcher," whose office may be at any convenient location in the district.

Like the railway train dispatcher, the power dispatcher has executive charge of the movements of great quantities of power. He has before him a board on which are plotted the various stations, trunk feeders and interconnections with other power systems. With the aid of telephones and signals he commands the units of power generation and coordinates his own system through interconnection points with other systems, constituting a great network which may distribute power over a radius of hundreds of miles.

The Arrangement of a Large Generating Plant.—In order to unify the discussion of the various details in the foregoing paragraphs, a description of the 160,000 h.p. Richmond Station of the Philadelphia Electric Company is given below. This station is an excellent example of standard practice, embodying no extremes, and yet combining simplicity of arrangement with high efficiency.

Richmond Station is located in Philadelphia on the Delaware River where an adequate supply of cooling water for condensing purposes is always available. The boiler house, generating room and switch house are located in adjacent buildings, the boiler house being next to the river. Next is the generating room and be ond ha the sv ch hou.e. Cables carrying the electrical energy away from the station run from the switch house to large industrial customers and to the company's distribution substations, also to an outdoor transformer and switchyard located at some distance from the main building.

Boiler House.—Twelve boilers are arranged in two rows of six each, with a firing aisle between. Coal is received at the plant in river barges, from which it is hoisted by grab buckets. It is passed through crushers to belt conveyors on which it is weighed and then distributed to overhead bunkers located between the two rows of boilers. It is then fed by gravity through pipes to the stokers which are driven by variable-speed electric motors. These stokers force the coal into the furnace underneath the fire in the required quantities. The ash, on leaving the furnace, is broken up into small particles by grinders driven by the stoker motor, and then drops into hoppers which are emptied into ash cars running on a narrow gauge railway on the basement floor (for description of other methods of handling ashes, *see* ASH HANDLING, MECHANICAL HANDLING). The cars in turn are emptied into an outdoor pit, from which the ashes are removed by a grab bucket and loaded on freight cars, trucks or river barges for final disposal.

Air for combustion is provided by a forced draft fan located on the top of the boiler. This fan forces the air through preheaters, where it is heated to a high temperature by hot flue gases, and then into the furnace. Two induced draft fans draw the gases from the furnace and direct them up the stacks.

An instrument board is provided adjacent to each boiler, on which are mounted instruments which indicate to the operator the amount of water being fed to the boiler; the pressure of steam; pressure of the air being supplied to the furnace for combustion; the pressure of gases in the boiler; the stoker speed (which indicates the amount of coal delivered to the boiler); and the amount of air being supplied for combustion.

Generating Room.—This is a large, well-lighted vaulted room next to the boiler house. The main generating units—two 60,000-kilowatt, 13,800-volt, three-phase generators driven by 20-stage General Electric turbines—are installed on platforms or "islands" about twenty-seven feet above the ground floor. The main steam pipes come in from the boilers beneath the platform floors, and the throttle valve control wheels extend above the floor. The turbine bases contain the oil reservoirs, and groups of large pipes lead the oil to the three main bearings of each unit. The governor mechanism is located at the boiler room end of the turbines, and the controlling inlet valves are located beneath the floor.

The condenser for each of the generator units is placed directly beneath the turbine, and is supported on concrete foundations through counterweighted levers which compensate for expansion. On one side of the condenser, on the basement floor, are located the duplicate motor-driven circulating pumps which take water at the rate of 78,000 gal. per min. from concrete intake tunnels extended under the boiler house to the Delaware river, and force it through the condenser and back to the river. One pump supplies sufficient water for the condenser, the second being a reserve pump.

Duplicate motor-driven fans, located adjacent to the generator foundation, provide cooling air for the generator. This air circulates through the generator over and over again, being cooled each time before entering the machine by a surface air cooler supplied with water by the condenser circulating pump.

The steam which has passed through the turbine is exhausted into the condenser, from which it is drawn in the form of water by means of condensate pumps. This water is then delivered through a series of heaters back to the boilers where it is again transformed into steam. On a platform beneath the turbine floor the first feed-water heater is located, taking steam from the 18th stage of the turbine. Just beneath this is a Radojet air ejector which assists in maintaining a high vacuum in the condenser. The steam used in the jet is later made to heat the feed-water. The water is then piped to a gallery between the generating room and the boiler room, where it passes through two more feed-water heaters supplied with steam from the 12th and 15th stages of the turbine, and finally through the boiler feed pump. This pump is of the centrifugal type operating at about 500 lb and

driven by an electric motor. In this gallery also, the evaporators are located, arranged to be cut in and out of service as additional water is required for the system. Above the heaters on a high platform, there is a surge tank for each unit—a device to equalize the variations in supply to the feed-water system.

Generators.—Each generator is installed on a common base with its turbine and is totally inclosed. Each machine has its own exciter carried on the end of the shaft. Instead of the small service generator attached to the turbine shaft as mentioned previously in this article, the source of power for auxiliaries essential to the continuous operation of the station, is provided by a transformer bank connected to the main generator terminals in such a way that the generator may be disconnected from the buses without interrupting the supply to the auxiliaries. These transformers, together with other transformers which supply the less essential auxiliaries from the main station buses, are situated outdoors in an areaway between the generating room and the switch house. An emergency service set consisting of a small turbine-generator is provided, being installed in one corner of the generating room.

Switch House.—Beyond the generating room is the switch house which is housed in a four-story structure and is an example of the isolated phase system. The three phases are placed each on a separate floor, phase "A" being at the top. Generator and feeder oil circuit breakers are grouped in concrete cells with asbestos doors which are kept locked. The circuit breakers and their disconnecting switches are operated by vertical rods coming up through the floors. The operating mechanism for each breaker and the handle controlling the disconnecting switches are installed on the ground floor below phase "C." There are two buses separated from each other by a longitudinal wall, and each bus is divided into two sections. Each generator and feeder circuit is provided with a main oil circuit breaker, and through another oil circuit breaker, known as the "selector" breaker, may be connected to whichever main bus is selected for operation. The feeder circuits are carried through current-limiting reactors and thence by cables in concrete ducts to the underground distribution system and to the transformer yard.

Transformer Yard.—This is a fenced enclosure situated at some distance from the station proper. The feeders from the switch house connect to two transformer banks which change the voltage from 13,800 to approximately 66,000 volts. From the transformer banks, the energy is supplied to the Philadelphia Electric Company's 66,000-volt system and to neighbouring utility companies.

Control Room.—The control room is located on the fourth floor of the power house over the transformer areaway between the generating room and the switch house. It has a wide bay-window which affords the station operators a clear view of the generating room. The operator sits at a desk, in telephonic communication with the system load dispatcher in the city, and with the generating room and the boiler room. The system load dispatcher determines the amount of load which the station is to carry, and issues directions for any major switching operations. In addition to telephonic communication between the control room and the generating room, a hand-operated indicating telegraph is provided for each generating unit for signalling between these points when placing a unit on the line or taking it off.

Before the operator are three switchboards, arranged in a semi-circle, one behind the other. The first is a bench-board or desk-like structure, divided into panels, each panel controlling a generator or several feeders. On this board are groups of small switches by which the operator opens and closes oil circuit breakers, adjusts the load and excitation of the generators, etc. The second board is a series of vertical panels, on which are mounted all meters and instruments for the generators and feeders. The third is the relay board and on it are mounted protective relays which automatically disconnect from the buses any circuit in which trouble may have developed. On this board are also located small switches and fuses for the low-voltage circuits from which the oil circuit breakers are controlled.

On each side of these three main boards there are 2,400-volt panels with control switches, meters and relays for controlling and metering the house-service circuits. One of these panels controls the steam-driven service generator.

Below the control room is a conduit or "pipe" room, in which all conduits carrying control and metering wires converge from all parts of the station. On the floor below the pipe room are the direct-current power rooms, in which are located motor-generator sets and storage batteries which supply power for energy excitation of the generators, emergency lighting, and for the operation of stoker motors and oil circuit breakers.

These are the main features of the Richmond Station. In the future two more units will be installed in this building, and later two more buildings like the present one will be built, bringing the total up to 12 generating sets with 72 boilers, and a total output of probably 700,000 kilowatts. (D. O. W.)

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II. HYDRO-ELECTRIC GENERATION

The extent to which the water powers of the world have been investigated and developed since 1910 forms one of the striking engineering features of the period. Although falling or flowing water formed the earliest of the natural sources of energy to be utilized for providing power, some two-thirds of the water power at present in use has been developed since 1910. The reasons for this are partly technical and partly economic. The technical development of the hydraulic turbine has rendered it possible to utilize any head from 10 feet to 5,000 feet with a high degree of efficiency and at such speeds of rotation as enable a reasonably cheap electric generator to be used. The development of high tension transmission at pressures up to 220,000 volts, has enabled the energy to be transmitted efficiently for considerable distances—up to 200 or 300 m. in some cases—so that it has become commercially possible to develop large water powers at sites far remote from any centre of industrial activity, and to transmit the energy for long distances to the nearest convenient centre. Technical developments in electro-chemical, electro-physical and electro-metallurgical processes, most of which require relatively large amounts of cheap electrical energy, have created a demand for large blocks of cheap power which can, under favourable circumstances, be satisfied more readily from a water power installation than from any other source. For a water power installation to be economically possible, it must in general be able to generate energy more cheaply than a steam plant. Even in countries which have an adequate supply of cheap fuel this is possible in many instances, while in countries which are normally dependent on imported fuel and which are favourably circumstanced as regards water power, the latter source of energy becomes all important.

The urgent demand for energy to supply the abnormal requirements of the war period, combined with the increased cost of fuel, was responsible for an unprecedented rate of development in many countries—notably in France, Italy and Canada. In France about 3,000,000 water h.p. is now developed as compared with 750,000 h.p. in 1914. In Italy the total output will shortly amount to 3,000,000 h.p., while the installed capacity of the water power plants in Canada is now almost 5,000,000 h.p. Japan which only lately began to investigate its water powers has, since 1916, developed over 1,200,000 h.p. In most of the other countries of the world, and notably in the U.S.A., Spain, Sweden, India, Brazil and Chile, hydro-electric development is actively taking place at a rate which shows little sign of slackening in the near future.

wer While any es ma e of a a lable or he most approxin a e kind the ro e nd cat on of he amoun. of water ble and developed in some of the chief

lions of Horsepower

	Avail-able	Devel-oped
. . . . .	0·0	0·25
. . . . .	32·0	4·8
Australia .		
Africa (East) .		
Africa (South) .		
Africa (West) .		
British Guiana	35·0	0·9
India and Ceylon		
New Zealand .		
Papua . . .		
. . .	3·7	0·3
. . . . .	54·0	0·6
. . . . .	8 o	0·1
. . . . .	5·2	3·0
. . . . .	1·5	0·8
. . . . .	7·0	2·7
. . . . .	6·4	1·6
. . . . .	13·3	1 8
. . . . .	3·0	0·9
. . . . .	6·0	1·4
. . . . .	8·8	1·6
. . . . .	4·0	1·6
. . . . .	55·0*	11·7*

of steam-flow available 50 per cent of the

appears that some 240,000,000 h.p. is oximately 30,000,000 is at present de-evelopment.

ic Energy.—While a large proportion from water power is utilized for indus-ıting and traction, an increasing propor-) and paper making and electro-chemical processes; indeed the chief outlet for ıe near future is likely to be in connec-and, probably, railroad electrification. eady used in these ways is large. Thus a alone the power absorbed in the pulp oproximately 2,750,000 h.p. Again, the cium carbide requires some 500,000 h.p. ıred that such products as aluminium, cyanamide, caustic soda, chlorates, mag-silicon are only rendered commercially s, it will be realized that the future de-manufacture is certain to be large. Ni-ely to make considerable demands. In oo h.p. is available for this purpose, and tion of the natural nitrate deposits, from orld's nitrogen consumption has hitherto diminution in fertility of many of the rowing areas of the world, the produc-rs by one or other system of nitrogen ar future, become a question of great

ailroads has made rapid strides of recent d electrification is not necessarily de-c power, it is noteworthy that all the ation systems are operated from hydro-ertain developments in the eastern part n the United States some 3,500 m of l while the Chicago, Milwaukee, St. Paul ified section of 850 m. which is sup-stations. In France, much of the track ıch has been electrified with the aid of Pyrenees, and it is anticipated that the 3,000 km. will be electrified within 10 ea The plan s upply n the e nes ha e a capac y o. close upon oo ooo h p The Orleans railway has a scheme for elec-trifying some 3,000 km. of its line, part of which is to be sup-plied from hydro-electric stations having a capacity of about 210,000 h p.

In Austria some 2,000 km. of line is in process of electrification and in Germany about 1,200 km. is now electrified, the power in each case coming mainly from hydro-electric stations. The Swiss railways are supplied from hydraulic stations built mainly for this purpose, and the ultimate programme of development com prises the electrification of the whole system by this means Spain Mexico, Brazil, Sweden and Japan also have a number of such schemes in hand and these and similar developments will provide a very large field for the utilization of water power where this is available.

Much energy is now being utilized in the United States of America for purely agricultural purposes In California, for example, there is in effect one vast system of electrical supply extending over a distance of 800 m. with 7,200 m. of high-tension transmission lines. This is fed from 114 hydro-electric stations interconnected with 30 steam plants, to give a total installation of 2,510,000 kw. A large proportion of this power is used in agriculture, a survey having shown a connected agricultural power load of nearly 636,000 h.p. in California in 1925. The Californian rice industry is almost wholly dependent on irrigation made possi-ble by electric pumping, whilst many of the mechanical processes involved in farming are being performed by electric power

In Sweden it is estimated that the power absorbed in the farm-ing industry is now about 270,000 kw The annual consumption is about 120 million kwh. or approximately 30% of the output of the State hydro-electric stations.

The economic development of many of the tropical depend-encies of the British empire, whose latent wealth is practically untapped, is directly interconnected with the development of their water-power resources. Not only would an abundant supply of such power enable railroads to be operated, irrigation schemes to be set on foot, and mineral deposits to be tapped and worked, but it would go far toward solving the labour problem which promises to be one of some difficulty in the future.

While those outlets for electrical energy which are now in sight promise to absorb all the energy which can be cheaply de-veloped for many years to come, there are many other probable directions in which such energy might find a new and profitable outlet. Among these may be mentioned the purification of municipal water supplies; the dehydration of food products; and the preservation of timber.

Lay-out of Hydro-electric Schemes.—The possibilities of hydro-electric development in any country depend essentially on its physical characteristics. Adequate rainfall is the first essen-tial. A boldly contoured region has many advantages, in that it is often possible to find elevated sites at which water may be col-lected and stored in close proximity to sites at a much lower elevation, to which the water may be led and utilized under the head corresponding to the difference between the two levels.

Since the horse-power which can be developed by each cubic foot of water depends directly on the working head, a high head in-stallation requires a much smaller volume of water than a low head installation of the same power, so that the pipe lines and the turbines are smaller and the installation is in general cheaper. Moreover, the volume of water which requires to be stored in wet weather in order to enable continuous operation to be carried out throughout the year is also smaller, and a comparatively small reservoir will often enable sufficient storage to be obtained at a reasonable cost.

For these reasons such countries as Norway, France, Switzer-land and Italy, which have mountainous regions subject to heavy rainfall in close proximity to industrial regions capable of absorb-ing large amounts of electrical energy, are very favourably cir-cumstanced for hydro-electric development. One development in Switzerland—at Lac Fully—utilizes the highest head on record. This is 5,412 feet, and the pressure of the water in the pipe line adjacent to the power house is 2,260 lb. per sq. inch.

In these high head schemes the water is normally brought from the supply reservoir through an open canal at a very flat gradient to a small chamber or forebay on the hillside above the power house, whence a short steep pipe line conveys it to the turbines. In one high head type, if a sudden closure of the turbine gates occurs, the water momentum in the pressure tunnel is absorbed in causing a surge up a surge tank, instead of in producing a heavy pressure wave in the pipe line. A noteworthy development of this general type is to be found in connection with the installations supplying electric power to Bombay from hydro-electric stations drawing their water from reservoirs on the eastern side of the Ghats.

But although high head sites offer many advantages, they are not essential for the successful development of hydro-electric energy. The great majority of those water powers of the world which are in reasonably close proximity to industrial communities, are indeed in regions in which the gradients are medium, and the aggregate power developed from medium and low heads is vastly greater than that from high head installation.

Low head schemes utilizing heads up to 40 or 50 feet, are usually located on rivers in which the gradient is small. In some cases a natural head is available owing to the presence of rapids or waterfalls, the water being diverted and led through a flume or canal to the turbines from which it is discharged into the low-level reach of the river. In other cases it is necessary to make an artificial head by means of a dam. A dam, by raising the natural level of the water, provides a certain amount of storage, but seldom more than is sufficient to store the night flow of the river for use during the day. A river scheme of this type can therefore only give a continuous output equal to the dry weather flow of the river. It is usually however, found economically sound to install hydraulic plant of a capacity greater than that corresponding to the minimum dry weather flow, and to install, as an essential part of the scheme, a steam plant capable of maintaining the output when the supply of water is inadequate.

Various types of low head development are adopted as they best fit the conditions encountered at the power site. Where a dam is built, the power house is often constructed on one flank of the dam with a short head race or tail race as is most convenient, and the dam itself is used as a spillway over which excess water is discharged in times of flood. Where the river flows in a narrow and steep gorge the powerhouse may sometimes with advantage be constructed in the dam itself, which now consists of a hollow reinforced concrete structure. Where the river forms a long bend, it is often possible to cut across the neck of the bend and to utilize the head between the two points.

In medium head schemes—utilizing between 40 and 200 ft. head—the layout is usually similar in broad outline to those involving either high or low heads. Where such a scheme involves the use of a long closed supply pipe to the turbines, having only a small gradient, somewhat special treatment, however, becomes necessary. Owing to the large inertia of the column of water in the pipe line, any sudden demand for water caused by opening the turbine gates on an increasing load causes a relatively large drop of pressure at the turbines, which renders governing very difficult. To reduce this difficulty, a surge tank is fitted to the pipeline at a point as near to the turbines as possible.

Turbines.—With the exception of the new low-head propeller-type turbines, the inward flow pressure turbine and the Pelton wheel are the only types of turbine used in modern hydro-electric schemes of any size. The type to be adopted depends largely on the available head. The Pelton wheel is a slower running machine than the pressure turbine and is therefore better fitted for very high heads. It has the further advantage for such heads, that since the water is discharged through one—or at the most two—nozzles, these may be of reasonable size when dealing with the small volumes of water normally available in high head schemes. The pressure turbine on the other hand with its full peripheral admission of water is well adapted to utilize the large volumes necessary in low head schemes, and its higher speed of rotation is also a great advantage in low and medium head plants, in enabling the cost of the to be Broadly speaking the Pelton wheel is more suitable for heads above about 700 ft.; the pressure turbine for heads below about 250 ft. in small units and below about 500 ft. in large units; while over the intermediate range of heads much depends upon the size of the units and the special circumstances.

With the exception of the new propeller-type turbines, all modern pressure turbines are of the mixed flow type, having inward radial flow through guide vanes surrounding the runner, and axial discharge. Pivoted guide vanes are universally used, speed regulation being attained by simultaneous rotation of these about their axes. Low head turbines—up to about 40 ft head—are usually set in an open forebay. Either vertical or horizontal shaft machines may be used, but the former are becoming more common especially for large units. For higher heads the water must be supplied through a pipe-line and the turbine is enclosed in a spiral casing so designed as to distribute the water evenly around the periphery of the guide vane ring. For heads up to about 120 ft this casing may be moulded in concrete, but for higher heads and pressures a metal casing becomes necessary. This may be of cast iron, cast steel, or of steel plate construction, and in order to give rigidity and increased safety in case of pressure surges is sometimes embedded wholly or partially in the concrete of the substructure. Modern development is tending in the direction of units having a single runner and a vertical shaft on the top of which the electrical generator is mounted The weight of the shaft, runner and generator is then carried from a single thrust bearing of the Michell or Kingsbury type. This type lends itself to a simple and efficient form of setting, while the friction losses are extremely low.

One of the great drawbacks of the low head turbine in the past has been its relatively slow speed of rotation, which necessitated either a slow speed and costly generator or expensive gearing As a result of experiment it has, however, been possible so to modify the form of the runner as greatly to increase the speed of rotation under a given head without seriously reducing the efficiency.

Such runners are characterized by their small number of vanes —often not more than four being used—which approximate in form to those of a marine propeller. In one of the latest types the Kaplan, the vanes are capable of rotation about their own axes so as to enable the vane angles to be adjusted to suit the varying flow of water at part loads. Further developments in the direction of increasing the speed are in active progress and promise to give important results. At the present time, however, turbines are in existence which are capable of efficient operation at speeds at least three times as great as would have been thought possible 10 years ago.

The pressure turbine is now built in units capable of developing upwards of 100,000 h.p., and this size could readily be increased if necessary. If well-designed and installed in a suitable setting the efficiencies are remarkably high. Efficiencies of 93% have been obtained on tests of vertical shaft turbines at Niagara and values approximating 90% are quite common In a medium head plant the following are typical values:—

Fraction of full load .	·25	·5	·75	·90	1·0
Percentage efficiency . . .	70	82	88	90	88

Pelton wheels are almost invariably built as horizontal shaft units with one or two nozzles, thus far in sizes up to 40,000 kilo-watts. Speed regulation is usually performed by a deflector which cuts off the jet from the wheel, acting in conjunction with a central needle or spear which slowly reduces the size of the jet while the deflector returns to its original position. The mechanism is operated by a relay cylinder supplied with pressure water or oil through a pilot valve actuated by the governor In a well-designed plant the instantaneous speed variation corresponding to a sudden application of full load should not exceed 12 to 15%. The difference between the initial and final steady speeds should not exceed 2% between full load and no load.

At constant speed the efficiency of a Pelton wheel falls off comparatively slowly as the load is A well wheel

should have approximately the following efficiences.

Fraction of full load	·25	·50	·75	·90	1·0
Percentage efficiency	77	83	85	86	83

Pipe-lines.—The lack of a suitable pipe-line has, until recent years, tended to retard the development of plants for very high heads. Under such heads the necessary wall thickness, even with a moderate pipe diameter, becomes too great to permit of the use of riveted joints. Recent developments in electric welding and oxyacetylene welding have, however, rendered it possible to construct suitable welded pipes and by their aid, and by the use of banded or solid drawn steel pipes in extreme cases, it has been found possible to harness the highest available heads.

The pipe-line for a water-power plant may be constructed of steel, reinforced concrete or wood. Steel is the most usual, riveted pipes being suitable for all but the highest heads. For heads up to about 200 ft., reinforced concrete pipes are suitable and have the advantage of not deteriorating appreciably with age As compared with steel pipes the materials are more easily transported and the friction losses are less. Large pipes are moulded in site, and as the bulk of the material is usually obtained locally, only the cement and reinforcement require to be transported for any distance. For small diameters, pre-moulded concrete pipes with loose-sleeve or spigot-and-faucet joints are often used.

For moderate heads, wooden pipes are extensively used in countries where suitable timber is cheaply available, and under favourable conditions have a useful life of at least 25 to 30 years. They are built up of wooden staves about 6 in. wide, shaped to the correct radius and joined end to end by thin metal plates driven into saw cuts on both the abutting ends, covering the joint. The staves are so arranged that the circumferential joints are not continuous. They are held together by circumferential steel bands which resist the bursting pressure, and whose diameter and spacing depend upon the pressure to be anticipated in each section of the pipe. The materials are easily transported and neither erection nor repair require any great degree of skill. If suitable timber is available the mill can be set up on the site and only the bands and shoes require transporting. As heads and diameters increase, the amount of steel necessary for the bands increases until it becomes comparable with that required for a steel pipe for the same duty.

In order that the walls of a wooden pipe should not decay it is essential that they should be kept saturated with moisture, and for this a certain minimum internal pressure is necessary. For this reason such a pipe is not suitable for heads less than about 20 ft., while the maximum suitable head is about 200 feet. Such pipes have been constructed in sizes up to about 18 ft. in diameter.

Generators.—Generators to be driven by hydraulic turbines range from the simple open-type machine, which is often applicable to small units, to constructions very similar to those of steam-turbine-driven alternators which are necessary for the largest high speed machines. On account of the very large outputs required in modern plants from a single unit running at the high speeds characteristic of the hydraulic turbine, the output per pole of the generator at normal frequencies is very large, and the cooling surfaces are small in comparison with the amount of heat to be dissipated. Special attention therefore needs to be paid to efficient ventilation of the rotor, which can only be obtained by a carefully arranged system of forced draught. Mechanically the rotor must be designed to withstand the rotational forces accompanying the "runaway" speed of the turbine, which may be from three to four times the normal centrifugal forces.

At the present time the energy is almost universally generated as alternating current on account of the simplicity and reliability obtained with a moderate generating pressure, which is readily transformed to the highest pressures which may be required for economical transmission Of the two types of alternating current generator, the synchronous and the induction types, the latter has come largely into use of recent years on account of its robustness of construction and simplicity in operation.

Occasionally the advantages of high-tension direct current may outweigh the essential difficulties of its generation, in which case the Thury system may be used. In this system all generators and motors are in series, the current remains constant, and the voltage is varied according to the power demand. All generators are series wound, each having a governor which either varies the speed of the turbine, or, if the speed of the latter must be constant, shifts the brush rockers. The maximum voltage per commutator so far constructed is 5,000. By using a large number of generating units, connected in series, the system pressure may be as high as 80,000 or 100,000 volts. All generator frames are insulated from earth and it is usual to surround the machine with a wide insulated platform to ensure the safety of the operators

Maintenance of constant speed is not of great importance, and the system therefore offers some advantages for such an installation, for example, as a tidal power scheme where the working head is continuously varying within wide limits.

Frequencies.—The question of the most desirable frequency of alternating current is simplified by the fact that in most countries two frequencies—a high and a low—have become recognized as standard. In the U.S.A. and Canada, either 60 or 25 cycles per sec. is most commonly used for general utility purposes and 25 cycles for railway power, although other frequencies (notably 50 cycles) are also used to a considerable extent On the Continent 50, 16⅔ and 15 cycles are standard; in Great Britain and South America 50 and 25 cycles. As regards the number of phases there is little freedom of choice, the question being largely determined by the nature of the load Single phase supply, though offering some advantage in simplicity of equipment, involves increased losses in the generators and generally less reliable performance. This system is only used where absolutely necessary, as for direct supply to alternating current railways using commutator motors. Of the polyphase systems three-phase is preferable to two-phase for general power purposes, since the plant is more fully standardized and therefore cheaper, while rotary converters are smaller, more efficient, and give better commutation on three-phase than on two-phase systems.

Voltage.—For distribution within a short radius of the power-house the voltage of generation and transmission will be the same as that required for the supply to consumers; but for transmission to greater distances, for which the voltage is stepped up, there is a wide choice of the voltage of generation. An unduly low voltage involves heavy and expensive bus-bars and switch-gear and in large units presents difficulty in the construction of the stator windings of the generators A very high voltage, on the other hand, requires a winding with many windings in series per slot, a greater thickness of insulation, and involves a generally reduced reliability. From the point of view of the construction of the generator it is desirable to have two conductors per slot and the stator current should then vary from about 300 amperes in the smallest to 1,000 amperes in the largest machines. It may therefore be shown that the most suitable voltage of generation, when not otherwise restricted for a three-phase machine, should vary approximately as follows:—

Output (kw)	200	500	1,000	2,000	5,000	10,000	15,000
Pressure (volts)	450	900	1,500	2,500	5,000	9,000	11,000

The power factor is here assumed to be 0·8. For two-phase machines the pressure should be about 0·9 times the above values One of the most important modern developments in transmission has been in the direction of reducing the losses by increasing the voltage of the transmission lines.

General Arrangement of Hydro-electric Stations.—The character of the development has a direct bearing on the general lay-out of the hydro-electric station. In a low head station, incorporated in a dam, the available space is limited by the width of the dam, and this in turn may be determined by the space required for the In ce t is usual in a low

head plant, to locate the switch gear and transformers either on floors above the machine room, or, as is becoming more common, in a separate building on the river bank.

There is a growing tendency to install all transformers and high tension switch gear out of doors. Isolated examples of this already exist in Norway, France, Italy and Spain, and the practice is becoming standard in the United States. It has even been proposed to place the whole generating plant outside, merely providing a portable shelter for use during repair work, and such open-air stations will no doubt arrive in the near future.

Conditions vary so much that no general rule can be made that can govern or guide all hydro-electric station design. It is evident that the generating plant itself, water wheels or turbines and generators should be located where the greatest advantage can be taken of the available head of water. This condition, however, is not sufficient to guarantee the most economical power generation at the given site. The cost of construction of the plant as a whole must be estimated for different settings and arrangements, and the one chosen that will result in maximum overall economy. The other component parts of the complete station, the transformers, switch-gear, lightning arrestors and the transmission line terminals must be fitted into the available space in the best possible manner. We find these installed in the structure and on the top of the dam in one station and removed to a nearby hill in another if sufficient space is not available nearer the generating plant. Every power site presents a complete new set of problems.

Many medium head plants operate with vertical shaft units. For a low or medium head station, in which the variation in tail race level may be great, the vertical unit has great advantages in that it enables the generators to be placed above the flood level while leaving the turbines free to be arranged at any convenient and suitable height above the tail water.

For small units the horizontal shaft machine has some advantages. Small electric generators are more economically built as horizontal shaft units since this allows of the simplest scheme of ventilation, and often enables a standard engine-type of machine to be used. In larger sizes again the horizontal type will often be preferable where, owing to governing difficulties the shaft has to be provided with an additional flywheel. In high-head stations, if turbine equipment has been found suitable, the horizontal shaft machine is almost universally used, largely because of its accessibility.

For the highest heads water wheels such as the Pelton wheels are installed. These belong to the horizontal shaft type of machine. Pelton wheels have been built in units composed of two water wheels with the electric generator between them, so that only two bearings are required.

Automatic Generating Stations.—The automatic generating station is especially suited to systems where numerous small-power falls are available. In such a case the expense of an operating staff at each would be prohibitive, but if each station can be made automatic, and all are linked into a common distribution system, the labour cost is reduced to a minimum. The first of such stations was set in operation in 1917. This is on the system of the Iowa Railway and Light Co., where it operates in parallel with a steam plant situated about two miles away. The automatic station contains three 500 kw. generators driven by Francis turbines operating under a head of 10 feet. Normally the starting and stopping of these sets is accomplished automatically through the medium of float switches actuated by the change in the level of water above the dam. Provision is also made for controlling these operations as well as the gate openings of the individual turbines by push buttons in the central power-house.

Another system of automatic control is used in a station recently opened by the Adirondack Power and Light Co. This is capable of developing 7,300 kw. at 6,000 volts. The control is arranged by a switch in the high-tension line some miles away. To start the plant this transmission line switch is closed. This energizes a series of solenoids one of which is connected to the pilot valve of the governor and one to an interlock on the turbine gate; while two others release the water pressure brakes. The turbine gates are balanced at about 30% gate opening, and so automatically open when released. The speed of the unit then increases until at about 95% of synchronous speed a relay closes the circuit breaker connecting the generating unit to the transmission line. The unit then comes into synchronism and the field switch closes. The unit is now excited and under governor control and takes the load corresponding to the governor setting. There are a number of protective relays and devices, and any kind of trouble causes the unit to shut down.

The development of automatic generating stations is proceeding steadily and this method of operation promises to do much to render it economically possible to utilize many low-head river sites which have hitherto been neglected.

Combined Operation of Hydraulic and Steam Plants.—Except where a large amount of storage is provided the variability of river flow makes it impossible to utilize more than a fraction of the total available energy unless generating machinery is installed which will have to be idle during the greater portion of the year. Broadly speaking it is found that the most economical results are obtained when the capacity of the turbines is such as will enable them to be run at full load for about six months in the year.

By operating a steam plant in conjunction with the hydraulic installation, it becomes economically possible to increase the capacity of the hydraulic plant, the defect of its output at times of less than normal flow being made good by the steam installation. The latter also serves as a stand-by in case of a breakdown of the hydraulic plant. (*See* SUPER-POWER.)

Most large hydro-electric power systems in 1928 included one or more steam plants as part of the system. The best method of operation of such a combination depends upon the type of load, the storage capacity of the hydraulic system, etc., and can only be determined by a consideration of the special circumstances of the individual plant. In general, since for maximum economy a steam plant requires to operate at something approaching its normal capacity, at times of low water the steam plant operates continuously, carrying the base of the load, while the peak of the load is taken by the hydraulic plant. On the other hand, in a system having a very long transmission line it has been found more economical to let the hydraulic plant carry the base of the load, working at a reasonably high load factor, and to carry the peak of the load by the steam plant. In this method of operation the cost of the transmission line is less than if the reverse method were adopted, and the saving in this respect may more than counterbalance the extra expenditure due to the less economical operation of the steam plant.

While in the early days of hydro-electric developments criticisms were justly leveled at the inaesthetic nature of such developments, much attention has been paid of recent years, more especially in Switzerland and in Italy, to the architectural possibilities of the hydro-electric plant. These plants stand at the foot of the mountains overlooking the plains or in a setting of rock at the mouth of a narrow gorge; nearly always are they located where the architect should be impelled to add beauty to usefulness even without the fear or the pressure of criticism. (*See* also TURBINE, WATER.)

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ELECTRICAL POWER IN AGRICULTURE. Great strides have been made in the application of electricity to agriculture. Already, many farmers are using electric light and power. With the growth of regional electricity schemes we may expect to see agricultural operations everywhere modified by the use of electric energy. Good light is as beneficial in a farmhouse as in an urban dwelling, in a cowstall as in a factory. The electric motor is simple, robust and easy to start and stop; it gives a steady pull, and, with the usual charge ranging in Great Britain from 1½d. to 3d. an electric unit for power, it is cheap to work.

Barn Machinery.—Most English farmers rely on an oil-engine which is used (roughly in proportion to the acreage of the farm) to drive barn machinery *i.e.* chaff-cutters, root-pulpers

ake and oat crushe s e Th se ma h nes ab o b from to H P accord ng o ze On a grass farn the eng ne perh ps $\frac{1}{2}$ to H P ma work on ... o o three hours a week in winter and be hardly used in summer when all the stock is out on the pastures. The annual consumption may be something like 1 H.P. hour per acre of land or, say, 600 H.P. hours per square mile of country, equivalent to 450 electric units or kilowatt hours On an arable farm, where there is much preparation of food, including perhaps the grinding of barley-meal, an engine of 5 to 8 H.P. may work several hours a day, and the annual consumption amount to about 12 H.P. hours per ac., that is, about 7,000 H.P. hours or 5,000 electric units per square mile.

Cultivation.—The greatest consumption of power in agriculture is in field cultivations such as ploughing. On most farms, this work is still done by horses. The only places where they have been replaced successfully by mechanical power are in flat areas with large arable fields. There ploughing can be done more economically by tractors on light land and by steam tackle on the heavier clay. On a farm where three quarters of the area is arable land, the annual consumption of energy in ploughing may amount to 15,000 to 20,000 H.P. hours per sq.m., and half as much again may be used for other cultivations, a total of 22,000 to 30,000 H.P. hours per square mile. Thus, on arable farms the energy needed for field work is considerably greater than that required to drive barn machinery.

Electric Ploughing.—Electric ploughing has been tried in France, Germany, Italy and elsewhere, and is generally carried out by contractors. The most usual method is to haul the plough backwards and forwards by means of a wire rope pulled by a motor mounted on a wagon at each side of the field, just as in steam ploughing. In a modification of this method, a single motor only is used, the wire rope passing round four anchored pulleys, two of which are moved as the plough proceeds. Experiments have also been made in which the motor is placed on a carriage attached to the plough, and current supplied to it through an insulated, flexible cable, which is unwound as the carriage and plough move one way across the field and wound up again as they move back in the other direction.

Costs.—It is difficult to get comparable figures of costs. A committee of the Institution of Electrical Engineers (Aug. 1925) quoted the prices of French contractors for ploughing to depths of 6 to 14 inches at sums equivalent to 16s. to 32s. per acre. The quotations of East Anglian contractors for steam ploughing range from 17s. to 25s. per ac. according to depth (say 8 to 14 in.) and soil. The cost to a farmer of ploughing with horses is generally reckoned at about 15s. for light and 28s. for heavy land per ac. but, if this too were done by contractors, something must be added for profit

Both steam and oil engines have the great advantage of being self-mobile; they can move about the roads and on to the field under their own power. With electric ploughing, the need of taking wires to each field, the great weight of the motors and carriage, and the cost of hauling them about with horses or tractors, militate against its success It seems likely that, unless some new method or improvement is applied, electric ploughing will make no headway, and that the use of electric power in agriculture will be restricted to the driving of stationary machinery.

Special Machinery.—Besides the ordinary barn machines, less common implements must be brought under review. For threshing corn, smaller farms mostly rely on travelling threshing machines worked by steam traction engines. Some larger arable farms, however, have their own threshing plants Where current is available, the machine can well be driven electrically with a motor of from 12 to 15 H.P. according to size. It is stated that, owing to the steadier pull of the electric motor, better threshing is done than with a steam-engine. On certain farms, power is used in other special ways. For instance, where a tower silo is installed, power is wanted to cut up the fodder and to lift it into the silo. Ensilage is sweet or sour chiefly according as it is made above or below a temperature of 47° C., and German experiments show that it may possibly be worth while to heat the fodder artificially by passing an electric current through the silo.

P h ps t e g e. a..antage of electric current is that power need only be used to the amount actually required. Motors of quite small size are made which will drive light dairy machinery horse-clippers, fans for incubators, and other implements which absorb too little power to make it worth while to start an oil-engine to run them. The number of such implements is sure to increase as electric supply becomes more common. As regards dairies, milking-machines and also separators, clarifiers and butter churns are very suitable for electric drive. Dairymen, and perhaps fruit-growers, may find it profitable as time goes on to install refrigerating machinery. This may give another demand for power on certain specialized farms.

Poultry.—To turn on electric light in poultry houses on winter evenings and give the birds an extra feed is found to increase the number of eggs laid. The rise in the total number laid throughout the year is insignificant, but, since eggs are worth more in winter, the redistribution more than pays for the cost of light, food and extra labour. Incubators can more conveniently be heated electrically than in other ways; by passing heated air through the apparatus by means of an electrically driven fan, uniform temperature and efficient ventilation can be secured

Plant Growth.—Experiments indicate that plant growth is stimulated by a high voltage current of some milliampere per ac. passing as a discharge to the crop from a network of overhead wires, which are kept at 20,000 to 60,000 volts above the potential of the earth. Application for six hours a day for one month early in the growth of the crop seems quite as effective as a longer treatment. With certain cereals, an increase in yield of 20% has been obtained, but the results are not always assured, and the matter is still in an early experimental stage. Other experiments, carried out in America and elsewhere, show that electric light, both arc and incandescent, in greenhouses, has an effect in accelerating the germination of seeds and hastening the growth of certain vegetables, the effect depending somewhat on the colour of the light.

Electric Supply.—In the neighbourhood of towns, and in industrial and mining areas, many English farms are supplied with current from central power stations. Most of these stations now produce three-phase alternating current, and the corresponding squirrel-cage type of motor is very suitable for farm use. Further developments of this kind may be expected, but the purely agricultural demand is not enough to carry a network of mains over the countryside with the high costs of erection prevalent in Great Britain. Experience shows that the demand for light and power combined varies from 1,000 to 6,000 electric units per sq.m., in good agreement with the estimate for power alone from oil-engines, as given above. In towns, the consumption may be a thousand times more. Again, for long distances, in order to economize copper, high voltages must be used; these are dangerous, and must be transformed to lower pressures for domestic or industrial purposes. Transformers are expensive, and no ordinary sized farm consumes enough power to carry the cost of a high voltage transformer. Hence arises the apparent anomaly that a farm with high voltage mains running through it may be unable to get power. But, where a chain of villages creates a considerable demand along a definite line, or where pumping or irrigation needs a steady supply of power, the distribution of central station current in rural areas may become possible, especially if produced by cheap water power.

In many other countries rural electrification has been developed further than in England, partly owing to the less expensive standard exacted by legislation for the erection of overhead conductors. As an example of what has been done in a country often cited as a model, the following details of electric supply in an agricultural area in the south-east of Sweden may be given. The total area is 194 square miles, containing 161 square miles of arable land, with a population of 157 to the square mile, of whom 60% are dependent on agriculture. The district is supplied from a transformer on a high tension main; from this station current is distributed at 20,000 volts and transformed down by steps to 220 volts. There are 2,600 consumers in the whole area, and the total annual consumption is about 1,050,000 electric units (kilowatt-hours). This is equivalent to 404 units per consumer or 33 units

per inhabitant; 3,400 units per square mile or 8½ units per acre. The total cost of installation of the country lines and transformers was about £60,000. The average charge for energy is 3½d. per unit, which, with meter rents gives a revenue of £12,300. This is found to cover the total costs and leave a small profit.

It will be seen that the consumption of power is about the same as that estimated above for stationary farm machinery in corresponding areas in England. The advantage held by Sweden is not that more power is used but that the costs of construction and distribution are less.

The establishment in 1927 of an Electricity Commission for Great Britain will lead to greater uniformity in voltage and frequency, to a decrease in the number of generating stations, and, it is hoped, to a cheapening in costs.

Where current from a large power station is not available, a village supply may be feasible; a considerable number have been successfully installed in England, some worked by small waterfalls, others by oil-engines. If water be plentiful, turbines and dynamos may run day and night, and a very cheap supply be obtained; but in other cases the energy must be stored in batteries of accumulator cells, which are costly and short lived. Whenever cells are to be charged, alternating current is, of course, inapplicable, and direct or continuous current must be used.

When no public supply can be obtained, there remains the question of a private installation. If occasional power to drive barn machines alone is wanted, it is obviously better to drive directly from a small oil-engine. But, if good light be wanted, and use can be found for motors of fractional horse power in dairy or house, a private electric plant may be worth consideration. The dynamo is generally driven by a water turbine or oil-engine, but the use of windmills seems now becoming possible. (*See* also FARM MACHINERY and TRACTORS.)

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PRACTICAL WORK ON THE ALL-ELECTRIC FARM

The following account of practical operations is derived from the experience gained on a British farm in Sussex.

Electric Light.—The use of electric light is a great aid to the safety and convenience of work in the barns, byres, stables, etc., where there is always inflammable material lying about. The farm worker in the electrically lighted building is able to do far more work than he would in the building where the only form of illuminant is the old-fashioned hurricane oil lamp. It has been shown by careful test that cattle can be fed with a saving of over a third of the usual time. During the winter months a great deal of work has to be done in the buildings after dusk or before dawn and the preparation of foodstuffs or the cleaning of byres by the aid of a poor light is not an easy task. Some time ago on the farm here described, the amount of milk produced was carefully checked; it was found that after the introduction of electric light into the cow byres much less milk was lost through spillage; the value of the milk thus saved was nearly sufficient to pay for the cost of electric light. It is the general experience on the continent of Europe, that as soon as electricity is available, the first thing done by the farmer is to light the byres and stables; his house comes last. The next step is usually the lighting of the poultry houses in winter to obtain an increased egg supply. Careful investigation shows that while the hens do not lay more eggs per annum through electric lighting, it is possible to alter the distribution of the laying period with the result that from 10 to 30 per cent. more eggs are obtained at a time when eggs are at their highest prices.

Normally, the supply of eggs is considerably reduced in winter because a good deal more than half of the day is spent by the hens on their perches. In the first four hours of this time the hen has digested almost the whole of the food contained in her crop and is afterwards drawing on the stored fats in her body which should be utilized for egg production. The electrically lighted house, however, reduces the number of hours sleep to the ample amount of ten a day; thus the birds are kept active for about 14 hours and are given a longer period for obtaining exercise and consuming food. The hours at which the lights are introduced vary according to the opinion of the poultry-man; the management described favours the morning and evening lighting system. Lamps of 40 candle-power are used and these are placed in scientific reflectors for distributing the light evenly over the feeding and scratching space in the house. As the switching on and off of the lights regularly at definite times would of necessity prove very inconvenient to the poultry-man (and electric lighting is apt to bring on a moult) automatic time switches are installed. These switches not only turn the light on and off but also dim the lights for a period of 15 minutes before switching on and off. This dimming arrangement is really essential when lights are switched off after dark, as its gives the birds an artificial dusk and yet provides sufficient light to enable them to return to their perches. The clock is fitted with a self-winding device and also an astronomical attachment. The latter automatically switches on and off a few minutes earlier or later each day, according to the earlier or later rising or setting of the sun. Careful records have been kept and it has been found that the total cost of electric light for the whole period during which lights are required amounts to about the average price of one egg per hen, in return for which 15% more eggs are laid at times of top prices.

Machines in Farm Buildings.—One of the outstanding advantages of electricity on a farm is that it can be used to drive nearly every type of farm machine.

When a farmer begins employing an electric drive he generally purchases two portable electric motors, one small one of 2 to 5 horse power for use with various machines, and a larger one, of 15 to 30 horse power, to operate a thrashing machine. Often a motor of 10 to 15 horse power is employed to drive a counter-shaft in place of an oil engine. In the course of five or seven years, it will be found that he is gradually adopting individual driving of his machines—in spite of economists' and engineers' calculations that this is not a good financial method—and often increases to as many as 15 electric motors. Though this practice may not seem sound, it is so, for after all labourers' wages have to be taken into account. The machine that is ready at a turn of the switch, is far more economical than one where the portable motor required to drive it has to be dragged into position and lined up. Again, the losses in driving a counter-shaft (often as much as 3 horse power out of a main drive of 8) are eliminated.

Milking Machines.—The electric milking machine was at one time not considered an economic proposition on a small farm where the dairy herd did not exceed ten. This, however, is not now the case, for small portable machines are available. These machines are driven by a one-sixth horse power motor and their current consumption is very low; they do not require any installation and are in fact just as reliable as the larger machines. Milking machines are often condemned because of the high bacterial count in the milk thus produced. This, however, is not the fault of the machine, but of want of cleanliness and care.

Thrashing Machines.—The thrashing machine on the farm in question is self-propelled and self-contained. It consists of a petrol-electric ex-omnibus chassis on which has been mounted a six-foot drum, ball bearing, thrashing machine. An electric motor has been erected on an angle iron framework on the front of the thrasher. This motor is directly connected to the thrashing drum through a flexible coupling. As is usual in this type of petrol-electric vehicle, the petrol engine on the chassis drives an electric dynamo. The current from this dynamo can be utilised either for propelling the vehicle or driving the motor connected to the thrasher. When the machine is used for thrashing, the electric motor is connected to the farm power lines; if however the machine is sent to a neighbouring farm where an electric supply is not available, the electric motor is operated from the dynamo on the machine. This equipment can proceed along the roads at a speed of 12 miles per hour. An electrically driven thrashing

machine has the advantage that about five per cent more grain is threshed out owing to the steady speed of the motor.

Electric Ploughing. The large electric plough has now become a usual sight on many large continental farms; over 200 are now in use in Europe. Its usefulness is, of course, restricted to large scale operation. Many seem to imagine that a farm equipped for electric ploughing must necessarily be one mass of overhead lines. This, however, is not the case, since the electric plough operates anywhere within a quarter of a mile from the source of supply, and farms are generally long in comparison with their width. Hence one line along the major axis of the arable portion of the farm will usually suffice. For the individual farmer a smaller type of plough is essential. On the Sussex farm described here, the management has for 5 years used the only working electric plough in England. The equipment consists of a two-wheeled carriage upon which is mounted a 12 horse-power motor with a speed reduction gear. There are also mounted on the carriage two cable drums, either of which can be driven by means of the motor. The equipment is anchored in a convenient position on the field, and adjacent to the overhead lines. The set operates on the old round-about haulage system. A double furrow anti-balance plough is used and this is drawn to and fro across the field by the steel rope attached to the drums mounted on the carriage. The speed of ploughing is from one-third to one acre per hour, varying with the nature of the soil and depth of furrow ploughed, five acres per day being the average. The great advantage of the small electric plough is that the ploughing can commence by merely pressing a switch. The objectionable hard "pan" made by the tractor is avoided, as only the plough passes over the ground. The consumption of electricity with this type is remarkably low; an acre of heavy arable land can be ploughed to a depth of six inches with a current consumption of 15 units; 25 units is sufficient to plough the same class of land to a depth of ten inches. The large electric ploughs, as used on the continent of Europe, plough up to 30 acres per day.

FURTHER APPLICATIONS OF ELECTRICITY

Ultra Violet Rays.—The present day electric farm is incomplete without its ultra violet ray equipment. Experiments have been made on cattle, pigs and poultry with these rays. It has been found that chickens so treated develop into strong vigorous birds in a much shorter time than under normal conditions. The treatment is only given during December, January, February and March, for about ten minutes morning and evening. Laying hens have been found to lay better during the winter months when treated with the rays.

Experiments have shown that the danger of rickets in young pigs, owing to their very rapid growth, can be considerably minimised by treating them with ultra violet rays. This is especially true during the winter. A farmer really has no business to rear young livestock in the winter-time when adequate health-giving sunshine is not available. However, the profits are greater, and the use of ultra violet rays combined with small doses of cod-liver oil, enable him to overcome adverse conditions.

Haymaking.—Adverse weather conditions constitute one of the greatest risks facing the farmer, for only too often excellent crops are ruined through rain at harvest time. Some years ago the manager of the Sussex farm, as a result of a number of laboratory and field experiments, decided to eliminate this risk, with the result that the hay and corn can now be cut when in the best condition, carted almost immediately, and stacked and cured with the aid of a small fan and an electric motor. This is not a drying but rather a bacteriological process. Stacks of from 15 to 100 tons have been cured without the aid of any pre-heated air. The method of procedure is as follows. On the place where the ricks are to be built, covered channels are prepared, provided with openings at about every ten feet of their length. High sided extensions are provided at the openings to give the air a lead into the cavities that are to be formed in the rick above. Over these cavities a drum or former is fixed. These drums are about 3 feet high and 2½ feet in diameter. The rick is then built in the ordinary way. When the crop reaches the level of the top of the drums, the latter are drawn upwards to provide a ventilating shaft. When

Saving Effected per Annum
by
Equipping a Medium Sized Farm with Electricity
(Cost of electricity 4d per unit)

Before electrification	£ s. d.	After electrification	£
Light			
50 gal. of oil @ 1/- per gallon	2 10 0	15–20 electric light points, consuming 300 units per annum	-
150 hours of labour cleaning and trimming lamps @ 6d per hour	3 15 0		
	6 5 0		5
Direct gross saving			£ 1
Indirect saving			
Additional milk output due to saving in spillage, 45 gals. @ 1/- per gal.			2
Time saved in the feeding of livestock by good lighting 182 hours per annum @ 6d per hour			4
Gross saving			£ 8
Milking			
Time for hand milking, 3½ hr. per day @ 6d per hour	£ s. d. 31 18 0	Time when electric milkers are used, 1¾ hr. per day @ 6d per hour	£ 15
		Electric power, 250 units @ 4d per unit	4
	31 18 0		20
Gross saving			£ 11
Cream Separating 7,300 gallons per annum			
Time for man to operate separator, 320 hours @ 6d per hour	£ s. d. 8 0 0	Time for man to attend to electrical separator 40 hr. @ 6d per hour	£ 1
		Electric power, 72 units @ 4d per unit	1
	8 0 0		2
Gross saving			£ 5
Pumping Water			
300 hours hand labour @ 6d per hour	£ s. d. 7 10 0	Power for operating pump, 65 units @ 4d per unit	£ 1
	7 10 0		1
Gross saving			£ 6
Chaff Cutting			
100 hours per annum to operate machine @ 6d per hour	£ s. d. 2 10 0	25 hours attending electrical machine @ 6d per hour	£ 0
		Cost of power, 18 units @ 4d per unit	0
	2 10 0		
Gross saving			£ 1
Total gross saving on:			£
Electric light			8
Electric milking			11
Electric separating			5
Electric pumping			6
Electric chaff cutting			1
			33
Cost of electrical installation:			£
Electric wiring in buildings			34
Belts, etc.			6
Electric motors, one of 2 horse power and one of 5 horse power			36
			76

this shaft has reached about two-thirds of the finished height of the stack, the drum is removed and pieces of trellis are placed over the cavities to prevent fresh material from falling down. The stack is then finished in the ordinary way.

The main ducts in the ground are led to a portable fan which is driven by an electric motor. The time when blowing commences on the stack depends upon the state of the grass. If the grass has been carried in a very wet condition, blowing commences immediately and is continued for ten to fifteen hours, thus ensuring the removal of the surface moisture.

The fan is afterwards operated for half an hour every twenty-four hours for the ten following days. The object of blowing is to keep the stack within certain temperature limits and thereby control the bacterial action. To this end temperature readings are taken at least twice a day. The thermometers are enclosed in steel cases and pushed into the rick about half way up for a distance of about 3½ feet. The size of fan used absorbs the full power of a 5 horse power electric motor. While the process was originally designed for curing hay, it has also been used successfully on cereals, thus saving the necessity of stooking and the consequent loss due to birds and vermin: incidentally also permitting of earlier ploughing.

The whole process is of course dependent upon bacteriological principles, coupled with a knowledge of the art of the ventilating engineer.

In the Garden.—The electric farmer also uses electricity for heating the soil in garden frames, dispensing with the erratic warmth of a horse-manure hot-bed. This is ideal for early spring crops. Excellent water melons have been grown in this way in succession to early lettuces. Around Stockholm where this system has been most extensively employed, 5,000 kilowatts of energy are now used during the nights for this particular application alone. Very intensive illumination of plants in bud quickly brings them into bloom; seedlings thus treated will not wilt.

COMPARATIVE FIGURES

Cost of Equipment and Saving Effected.—There is an increase of about 25 per cent in the capital expenditure of the electrified farm, but this can be recovered in a comparatively short time, usually about 3 years, whereas, in a factory, 10 years is the usual time allowed for the recovery of capital sunk in the enterprise.

The saving effected on a medium sized farm, when a few general machines are electrically driven has been carefully compiled, and the table on p. 163 shows how appreciable this is.

Now, 15% interest and depreciation on £76 equals £11 8s. 0d. Deducting this from the gross saving of £33 12s. 6d. shows a net profit to the electrical installation of £21 4s. 6d., so that, even if there had been no profit, the convenience and other indirect gains would have been well worth while. (R. B. M.)

UNITED STATES

In the United States the utilization of electricity in agriculture has advanced rapidly during the past decade and will surely increase even more rapidly in the near future. The greatest obstacle to the electrification of American farms is the great distance between them and the consequent cost of installation. The relatively small initial demand for electric power of a few scattered farms is generally not sufficient to cover the cost of bringing the power to the farms. For the economical generation of electricity large plants must be built as near as feasible to the centre of the load of the district which they serve. From the central generating plant the power is sent out at high voltage. Where power is to be transmitted long distances it is necessary to employ high voltage in order to reduce the size of wire and hence the cost of the transmission line. Should low voltages be employed, the size of wire required to carry the power with a reasonable loss would become so great that the cost would be prohibitive.

Cost of Electrification.—It has been found that the cost of serving the average farm with electricity is about five times the average cost of serving the average city customer. It is, therefore, necessary for the farmer to use about five times the quantity of electricity as used by the city customer in order for the cost per unit of electricity, kilowatt hour, to be the same. The problem of farm electrification, in its broadest sense, is one of finding uses for electricity on the farm which will insure the utilization of sufficient power to justify the service at a price the farmer can pay and the power company is willing to accept. To this end the National Committee on the Relation of Electricity to Agriculture was formed. This committee is composed of the following organizations: American Farm Bureau Federation; American Home Economics Association; American Society of Agricultural Engineers; General Federation of Women's Clubs; Individual Plant Manufacturers; National Association of Farm Equipment Manufacturers; National Electric Light Association; National Grange; National Electrical Manufacturers' Association; U.S. Department of Agriculture; U.S. Department of Commerce; U.S. Department of the Interior.

In 1928 associations in 24 States were studying the same problems, largely through the agricultural colleges and experiment stations. Their investigations have shown that many farms can find practical and economical use for the amount of electricity provided at the minimum charge. Some 200 separate and distinct uses of electricity on the farm are now listed. Many of these uses necessitated the design and development of special apparatus and devices, and as the service for the farm differs materially from other classes of the electric light and power business, it became necessary to draft special rates and regulations.

The price of electricity depends upon the relation between the expense of carrying the power to the point of use and the amount of power supplied. The rate forms generally provide for the financing of the line construction by the power company, thus making the farmer's capital available for the purchase of electrical equipment. While many forms of rural rates are in use throughout the country, there appears to be a general tendency towards standardization in two general types: (1) Monthly service charge plus a relatively low energy rate, usually in two steps. (2) a guaranteed minimum yearly revenue with various energy rates. A survey by the rural electric service committee shows that on Jan. 1, 1927, there were 227,442 farms in 27 States having service from high tension lines, which is an increase of 86% for the same 27 States over Jan. 1, 1924. On this basis, between 300,000 and 350,000 farms were receiving electric service on Jan. 1, 1927, and it is believed that the number of farms having their own electric plants is as great. This gives between 600,000 and 700,000 farms in the United States using electric power, or about 10% of the total number.

Use in the Household.—The first consideration of the farmer when installing electric supply lines to his farm is lighting and household equipment, consequently this line of apparatus has been developed and employed to a greater extent than that of power. The proper economical lighting of the farmhouse, outbuildings and grounds is very important and the principles of lighting must be observed if satisfactory and economical illumination is to be obtained. Furthermore, the special requirements of each room must be considered. Yard lighting is also very important on the farm. The intensity of the lighting need not be great but it should be such as to enable one to find one's way around easily. The fixtures and fittings should be weather-proof, and the bulbs should be protected from rain by a glass covering. In addition to lighting there are more than 40 electrical household devices. On account of the labour which it saves, the washing machine (*q.v.*) is generally one of the first pieces of electric household equipment purchased. The importance of having running water in the bathroom and kitchen, and fresh water for cattle, horses and other stock is generally recognized by the farmer; the pneumatic system is most frequently employed on the farm as it is cheaper to install, more sanitary, better adapted to automatic control and can be easily housed, either in the basement of the house, or in a cheaply constructed building in the farm yard. Elevated tank systems in which the water is distributed by gravity are employed to some extent, but the tanks and tank towers are expensive to construct, and deteriorate rapidly; the water freezes in the winter, and the system does not lend itself readily to automatic control.

The electrically operated household refrigerator (*see* REFRIGERATORS HOUSEHOLD) is rapidly becoming installed in the farm home. The need of refrigeration on the farm is generally greater than in the city, as larger quantities of perishable foods must be kept for longer periods. The electric range is a most convenient method of cooking food, but its intelligent operation is one of the most important factors. If meals are planned so as to use for the most part the insulated oven and boiler, the energy consumption can be greatly reduced below that required where the open grids are used. For satisfactory cooking with electricity, using automatic control, it is essential that the voltage applied be that for which the heating elements are designed, as the temperature of the elements drops rapidly with a decrease in voltage

An electric water heater should be used in conjunction with an electric range. The heater should not be larger than is absolutely necessary to provide the quantity of hot water needed, as losses by radiation are considerable. A well-insulated heater of about 3 gal. capacity hand operated, is usually employed for providing hot water in the kitchen, principally for dish washing. Electricity also finds large use on the farm in connection with radio. In April 1927, the number of radio sets on farms was 1,251,186. This number is about 25% of the total number of farms in the country. In Sept. 1928 it was estimated that the total number of sets on farms was 1,500,000, or about 30% of the total number of farms. The number of farms reporting telephones in 1920 was 2,498,493. The number in 1928 was perhaps 3,000,000, or about 50% of the entire number of farms in the country.

Dairying.—Many dairy farms have electric service. Electric lights are particularly useful in the dairy barns and milk house in order to provide illumination for the early morning and evening milkings and for feeding the cows, cleaning buildings, etc. The silo should be properly lighted not only for convenience and freedom of movement, but for safety as well. Electricity is largely responsible for the rapid development of the milking machine. The electric motor, owing to its light weight, simplicity of construction, cleanliness and constant speed, furnishes an ideal drive for the milking machine. Two types of these machines are in use, the pipe line machine and the portable machine. The pipe line machine, as the name implies, consists of a number of pipes installed in the barn with a vacuum pump located in a separate room. The portable type has the motor and vacuum pump mounted directly on the cover of the milk receptacle. This gives a direct suction to the machine and eliminates considerable leakage which occurs in the pipe line. The portable machine is usually arranged as a double milking unit; that is, one machine will serve two cows. The capacity of the electric motors for these double units is standardized at $\frac{1}{6}$ horsepower. The power required to operate the pipe line type varies with the type and efficiency of the particular machine and usually ranges from $\frac{1}{3}$ to $\frac{3}{4}$ horsepower per cow milked at one time. The time saved by the milking machine over hand milking is considerable. Tests show that with a herd of 15 cows, the saving in time amounts to 37½ minutes at each milking, or an hour and a quarter a day. The time saving per cow increases with the size of the herd. There are two serious problems encountered in the operation of milking machines: viz., low voltage and sanitation. Low voltage produces unsatisfactory operating conditions, but can be remedied by proper electrical installations.

The refrigeration of milk embodies two distinct problems; viz., the initial cooling for removing the animal heat, and the storage at a temperature sufficiently low to greatly retard the growth of bacteria. The initial cooling is accomplished by running the warm milk over some form of surface cooler, while refrigerated water or brine is pumped through the interior of the cooler. Usually the cooler coils are divided into two sections Cool well or spring water is pumped through the upper section and refrigerated brine through the lower section. Such an arrangement economizes in mechanically produced refrigeration, as approximately half the cooling is accomplished through the use of the cold well or spring water. The morning's milk is generally cooled to about 45° F, placed in insulated cans and taken immediately to the milk plant or railway station. The night's milk comes from the surface cooler at about 50° or 55° F, and is placed in cans and stored overnight, either in an insulated tank of refrigerated water or in an insulated cold storage room, where the temperature of the milk is further lowered throughout the night to around 45° F. Refrigeration is stored in the tank of water and also in the tank of brine which is located in the top of the cold storage room. Storing up refrigeration makes possible the use of a much smaller refrigerating plant, as the plant can be operated a longer time, thus storing up refrigeration which is available for quick action when needed

The pasteurizing of milk by electricity is little employed. The usual method is to pass the milk between electrodes, the milk itself forming a part of the electric circuit. The resistance to the flow of electricity offered by the stream of milk serves to heat the milk to a temperature sufficiently high to destroy the bacteria. Alternating current is employed, generally at a voltage of 220. The regenerative or heat exchange method is used to reduce the quantity of electric energy required to a minimum.

Owing to the large amount of hot water required in the dairy for washing purposes, it is impracticable to employ electric energy as the heating medium except when a very low rate per kilowatt hour is available. Many States require the sterilization of utensils employed in dairying, and electricity is being used to a considerable extent for this purpose. The type of sterilizer generally employed consists of a well insulated box containing the heating elements. The heating elements are placed at the bottom of the box and covered with a small quantity of water, while the utensils to be sterilized are placed on a false bottom just above the heating elements The temperature is automatically held at about 210° F. It should be noted that the operation of the cream separator at exactly the proper speed is very important for efficient separation. The practically constant speed of the electric motor, especially of the alternating current type, makes it an ideal drive for this class of work. Consequently, on the dairy farm where electricity is available, the cream separator is one of the first pieces of equipment to be electrically equipped. The average size of farm separator is provided with a motor ranging in capacity from $\frac{1}{8}$ to $\frac{1}{4}$ horsepower. The $\frac{1}{8}$ h.p. machine will handle up to 1,000 lb. per hour, while the $\frac{1}{4}$ h.p. will handle up to 1,400 pounds.

The heating of the drinking water for the dairy cow, and constant maintenance of a supply at the proper temperature, has served to increase the yearly average of milk production from 5 to 15%, the increase being greater in colder climates than in warmer. The milk tester is a valuable piece of apparatus for the dairy as it enables the dairyman to make more accurate selections in the building up of his herd on a butter fat basis. The energy consumption when operated electrically is very small and the speed of rotation is practically constant.

Bottle washers for the average dairy require about $\frac{1}{16}$ h.p. motor and operate at about 1,800 r.p.m. They are convenient and economical in the use of electric energy. The animal groomer is largely employed. It thoroughly removes the loose hair and dirt from the udder and flanks of the cow without permitting them to escape into the stable air and eventually into the milk. The control of flies by means of the electric fan is also largely employed. The usual method is to install vertical ceiling fans just inside the doors, the draft from the fans preventing the flies from entering. Electrocution screens have been used with some success in destroying flies and other insects around the dairy. Some trouble, however, has been experienced due to the short-circuiting of the wires by the dead flies.

Ensilage is one of the best feeds for dairy cattle, and practically all dairy farms are equipped for providing this food. Due largely to the different methods of operating the ensilage cutter, the energy consumption per ton of material ensiled is extremely variable. The size of machine, sharpeners of knives, speed of fan, length of cut, method of feeding machine and kind of material being ensiled all affect the energy consumption per ton. Dull knives will increase the energy consumption approximately 50%. The speed of the fan should be just sufficient to elevate the material into the silo. The motor load fluctuates over a wide range, depending upon the care and uniformity of feeding the cutting machine. Owing to this wide fluctuation of load it is very important that the wires connecting the motor to the transformer be

exceptionally large, especially if the motor is at a considerable distance from the transformer. In other words, the wiring should be so proportioned that there will be not over 10% drop in voltage at the motor terminals under extreme conditions.

Owing to the short time required for cutting ensilage for a single farm, and to the comparatively large size of motor necessary for driving the machine, a community-owned outfit is sometimes employed. The outfit in addition to the motor and ensilage machine, consists of a portable substation embodying the necessary transformers. This substation is mounted on a truck and transported from farm to farm to handle the ensilage cutting, threshing, etc. The portable substation eliminates the necessity of a bank of large transformers to supply the power for these jobs which are performed for only a short period of each year, and in this way lowers the cost of transformer installation for each of the individual subscribers. Such an outfit will provide ample power for any of the heavier farm operations where rotating machinery is used.

Poultry.—Electricity seems to be especially adapted to the needs of poultry farming. It has been known for years that artificial illumination so timed as to lengthen the day during the autumn and winter season serves to increase egg production during this period. The artificial lengthening of the day does not increase the total yearly egg production, but it does increase the output at the time of highest prices. The decrease of egg production during the winter months is obviously due to the fact that hens go to roost at twilight and consequently in winter they have less exercise, consume less food and lay fewer eggs. Artificial lighting of the poultry house in winter lengthens the hen's day; she therefore scratches more, consumes more food, lays more eggs during this season and thus more evenly distributes her year's production.

The average working day for the hens is from 12 to 13 hours from November to March. In the case of late maturing pullets it has often proved practicable to use the lights even earlier. To avoid sudden changes in the habits of the flock, the artificial day should be lengthened gradually in autumn and reduced gradually in the spring. The usual practice is to light from 5 A.M. until daylight and from dusk until 7.30 or 8.00 P.M. There is need for gentle brightening and dimming of the lights. If these are turned off suddenly and the flock is plunged into darkness they become demoralized and many roost on the floor. An arrangement is provided that will extinguish the lights gradually, to simulate the effect of the natural approach of twilight. A satisfactory method of doing this is to dim the lights down to at least half voltage for a period of from 10 to 15 minutes before turning them off entirely. When the lamps are dimmed, the hens instinctively go to roost in their accustomed manner.

The lights for the poultry house are placed about 6 ft. from the floor and 10 ft. apart. They should be fitted with cone-shaped reflectors 16 in. in diameter and 4 in. deep. The reflecting surface should be covered with three coats of aluminium bronze paint. With the above mentioned spacing 40-watt lamps will properly light 200 sq.ft. of floor space; therefore, to find the number of lights required, divide the square feet of floor space by 200. The nearest whole number will be the number of lighting units required. Should the poultry house be divided into pens, figure each pen separately. The energy consumption for lighting is from 3 to 5 kw. hours per month for each 100 hens. Warming the drinking water for poultry is necessary for maximum egg production. When the temperature is below freezing, hens consume about 25% more warm water than cold, and about 5% more when the temperature is above freezing. The result of drinking more water is better appetites and more eggs. Electrically operated dropping boards are employed to some extent, and have practically eliminated the manual labour required for cleaning the boards.

Electricity is the ideal heating medium for the incubation of eggs, because of the reliability and ease of automatic temperature control. Automatic thermostats are the heart of the incubator, consequently they should be sensitive, reliable, durable and maintain their setting. They should be capable of controlling the temperature inside the incubator to within plus or minus ½° F from the thermostat setting. The incubator should be well insulated in order to conserve heat, thus making it possible to control the temperature more accurately and to maintain the temperature for a long period in case the power should be cut off. It is the usual practice in designing incubators to provide in the heating element ½ watt per egg.

Chilling and over-heating are to be guarded against in the brooder. Electricity furnishes the most reliable source of heat for this purpose. The brooder should be equipped with a no voltage or temperature alarm to notify the poultryman when the power fails so that he can take the necessary steps to keep the chicks warm, such as placing a blanket over the brooder. A temperature alarm is further valuable in that it gives warning when the thermostat points fail to function. The temperature regulator need not be so sensitive as in the case of the incubator, as a temperature range between plus or minus 3° F from the thermostat setting is satisfactory. The area per chick under the brooder is one of the important factors in determining the energy consumption. The construction of the brooder and the temperature of the brooder house are other factors affecting the quantity of heat required. The area per chick allowed under the brooder varies from 3½ to 7½ sq.in. and an energy consumption of from 1 to 3 watts per chick. The maximum of 3 watts is required when the outside temperature is around 0° F.

The electric brooder, due to the even and dependable heat, has proved successful in the raising of turkeys. During cold damp weather the mortality rate among newly hatched birds is usually very high. This has largely been overcome by the employment of the electric brooder. Time and labour are saved the poultryman by the employment of electrically driven green feed cutters and bone grinders, which operate with a small energy consumption. The electrically heated oat sprouter provides an easy and satisfactory means of providing green feed requirements. A large, well insulated sprouter, when placed in a warm protected location, uses about 75 kw. hours per month for sufficient oats for 1,000 birds. A smaller type sprouter consumes about 15 kw. hours per month to furnish green feed for about 200 birds.

Extensive experiments have been conducted on the treatment of poultry with ultra-violet rays. The lack of vitamin D in the ration of growing chicks which are confined indoors, causes leg weakness or rickets. Vitamin D controls the utilization of minerals in the ration, and the use of this vitamin is greatly increased through the application of ultra-violet rays. These rays are present in sunlight, and poultry that are exposed to sunlight for the greater part of the day do not require treatment with artificially produced ultra-violet rays. Ordinary window glass, which is commonly used in the front of poultry houses, prevents the passage of these rays in sunlight, and it therefore becomes necessary to supply them artificially. The energy consumption of the ultra-violet lamp is small. About 7½ kw. hours is required per month per 1,000 chicks treated, one month of treatment generally being sufficient. In the case of hens about 100 kw. hours are required per month for each 1,000 birds treated. The ultra-violet lamp offers the poultryman a convenient method of maintaining the vigour of his flock or the vitamin content of the eggs during cold sunless days of winter when the birds must be kept in the house.

General Farming.—There are a large number of uses to which electricity has been successfully applied on the general farm. Among these are corn shelling, corn husking and shredding, hay hoisting, hay baling, grain cleaning and grading, grain elevating, fertilizer grading and mixing, feed grinding and mixing, wood sawing and the driving of equipment in the farm shop. The general-purpose motor employed for driving various machines that are used only for a short period, such as concrete mixers, threshers, ensilage cutters, etc., are quite generally employed. The motor together with its controller and a special flexible cable are mounted on a truck or a sled which can be drawn to the location desired.

Irrigation.—Electricity is used extensively for irrigation at the present time and its use for this purpose is increasing rapidly. The lower initial cost of the plant together with the simplicity and ease of operation serves to increase its popularity for this class of service. While in arid or d regions irrigation is necessary

or successful farming is also receiving attention in connection with land that are subject to possible temporary drought, especially when such crops are grown that require considerable moisture and that suffer severely even from a short drought.

Drainage.—Drainage plants are usually of large capacity and hence a large amount of power is consumed in their operation. While a large percentage of these plants are driven by Diesel, semi-Diesel or steam engines, many are driven by electric motors, and the number of electrically-driven plants is rapidly increasing. The low initial cost of the motors compared with that of the engines, the smaller installation cost due largely to the avoidance of massive foundations, the simplicity of the motor and the ease and convenience of operation are factors in favour of the electrically-driven plant and are largely responsible for the rapidly increasing use of electricity for this class of work.

Orchards.—The apparatus for washing poisonous sprays from fruits, the grading of fruits, stationary spray plants, etc., are successfully operated by electric motors. The electrically-operated refrigerating plants are largely employed for the cold storage of fruits, berries and vegetables on the farms, due primarily to the ease with which the temperatures can be controlled. The dehydration of fruits, vegetables, hops, nuts, etc., by means of electricity is being extensively employed because of its reliability, ease of operation and automatic temperature control. A novel use for electricity for orchard and truck farms is that of trapping insects, by means of an electric lamp suspended over a pan partly filled with oil. (J. T. B.)

ELECTRICAL POWER TRANSMISSION. The transmission of electrical energy has now been so developed as to supply inexpensive and reliable power over distances as great as several hundred miles. Its service in making cheap water power available is obvious. A great share of all power is steam generated, and the function of transmission is equally essential here. This is not because it may permit locating generating stations at the coal mines, a plan that is frequently discovered to be uneconomical, but because steam power generation may be economically concentrated in large central stations if that power can be transmitted to the user. Such stations can be located where adequate supplies of cold water are available for condensing steam —an operation necessary to high efficiency. Larger generating units (inherently more efficient) can be used and greater refinements adopted to increase the efficiency of generation. (*See* ELECTRIC POWER GENERATION.) The number of attendants in a large station is about the same as in a small one, but one large station replaces many small ones with a consequent saving in wages. Further, the equipment necessary for a given generating capacity can be furnished more cheaply in large units than in small. This is true not only for prime movers and generators but for boilers, auxiliary apparatus and even buildings. Actually, however, more expensive apparatus is used in large stations in order to obtain very high efficiency. The second fundamental reason for the economies available through power transmission is as follows: When small isolated stations are used, each station must be large enough to supply the maximum demand for power in its area. The total generating capacity required in the whole district is equal to the sum of the maximum demands. These demands, however, do not all occur at once. There is a certain diversity, as it is called. If one large station supplies the district, its capacity need only be as great as the maximum simultaneous demands, or total load from all the areas. With the maximum demands from the areas occurring at different times the load is maintained longer on the large station and the output for the whole day is larger in relation to the generating capacity, thus making the load factor higher. It is for this reason that the efficiency of a large station is so important. A third advantage that transmission offers is that of increased reliability. This applies chiefly where several generating stations are concerned, because when trouble occurs in one station, power may be transmitted from others to replace the output of the affected station. Further economies also are possible through such interconnection of stations and will be explained later.

A transmission system as actually developed to take advantage of all these possibilities may include several generating stations both steam and hydro-electric. There will be transmission or "tie-lines" between stations for feeding power back and forth as desired, and also transmission lines connecting generating stations to sub-stations. Each sub-station may be fed by lines from several generating stations. From the sub-stations low voltage lines and feeders bring the power to the consumers. Transformers are used to step the voltage up and down, switches are used to connect and disconnect different lines. The actual transmission lines may be either underground or overhead. When overhead, the conductors are usually strung on poles or towers to which they are secured through insulators supported on cross-arms. The insulating support and the air are relied on for insulation though at the lower voltages fabric and rubber insulation is also used. The underground lines are cables, that is, a conducting core surrounded usually by wrappings of oil-impregnated paper, the whole being protected by a lead sheath.

Development.—The desirability of transmission was obvious from the first, but there were intricate problems to be solved. The loss of energy in the conductors, which varies with the square of the current, limited the amount of power and the distance to which it could be sent. True, this loss could be reduced by increasing the size of the conductors, but that was expensive. Lord Kelvin early showed that the best combination is that in which the annual cost of the energy loss equals the interest on the investment in the transmission line. There is a loss of voltage, also, that increases with the current. Since the luminosity of electric lights varies practically with the fourth power of the voltage, such a voltage drop is very objectionable. The power sent over a transmission line equals the product of voltage and current. If the voltage can be increased the current can be decreased accordingly without decreasing the power. Thus the energy loss and the voltage drop may be cut down. Unfortunately, the voltage for domestic service is limited to 110 or 220 volts for reasons of safety and convenience. Edison found a way to double the transmission voltage of a direct current by the use of a three wire system which made it possible to serve 110 V. lights from a 220 V. system, but further extensions of this scheme were impracticable.

At one time hope centred around the scheme of connecting the lights in series, allowing the same current to flow from one light into the next, the total voltage being the sum of the voltages used across all the lights. Thus small current and high voltage might be obtained; but though the voltage across each light would be small, the potential of the circuit would be unsafe, and the connection very inflexible because it was necessary that all lights should be burning at once. The problem thus took form as one of transmitting at high voltage but distributing at low voltage with lights, motors, and heating devices connected in parallel and operating independently. Up to this time only direct-current systems had been used. In such a system the current flows continuously in one direction around the circuit, and one generator terminal remains positive in voltage, the other negative. The fruitlessness of early efforts to develop a satisfactory transmission system with direct current turned the attention of investi-

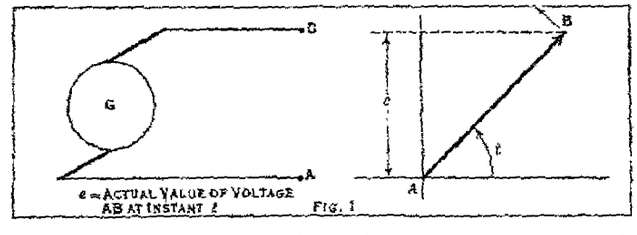


FIG. 1

gators to alternating current. In an alternating-current circuit the direction both of current around the circuit and of voltage between the generator terminals reverses periodically and smoothly so that if their values are plotted against time a sine wave results. A complete change from positive to negative and back again is called a cycle. Alternating-current power is ordinarily generated at 25, 50 or 60 cycles per second. It is customary to represent alternating voltages diagrammatically by means of rotating arrow-

or vectors. Thus in fig. 1, A and B are the terminals of a generator. The voltage between A and B is represented by the vector AB, rotating counter-clockwise about A. The voltage from A to B is positive while the rotating arrow points upward, and negative while it points downward. The distance of the arrow head above the horizontal line gives the actual positive or negative value of the voltage. All problems in alternating current design may be solved by means of such a vector diagram.

Following the shift of interest to alternating current, the transformer was developed by such pioneers as Stanley, in America, and Zipernowski, Deri and Blathy, in Hungary, in 1886. The transformer consists of an iron core surrounded by two coils. One coil—the primary—is connected to a source of alternating voltage which tends to force current through the coil, first in one direction, then in the other. This change of current sets up a magnetic flux in the iron linking the two coils; the flux induces a voltage in each coil which has the same value per turn in both coils. Enough current flows to induce in the primary coil a voltage opposite and almost equal to the impressed voltage. Since the voltage in each turn is the same, the voltage induced in each coil is proportional to the number of turns; but the voltage induced in the primary is nearly equal to the impressed voltage. Therefore the voltage induced in the secondary bears practically the same ratio to the impressed voltage as the number of secondary turns does to the primary. The voltage available across the secondary can be made whatever desired by winding the proper number of turns into the coil. Thus the problem of a high transmission and a low distribution voltage is solved. When a voltage higher than the generator voltage is desired a transformer can be used to step up the voltage; at the other end of the transmission line transformers can step the voltage down again. Alternating current is necessary because the electro-magnetic induction in the transformer is caused only by a change of magnetic flux, which in turn depends on the increase and decrease of current. Mechanical motion can produce the same effect, but one of the great advantages of the transformer is that there are no moving parts, a fact which makes it most efficient.

The alternating current, however, introduces certain minor difficulties, the chief of them being this very induction that is essential in the transformer. That characteristic of the circuit which produces induction, the inductance, acts upon the current like inertia. Due to the inductance the current does not change direction or arrive at its positive and negative maxima as soon as the voltage. Engineers say the current lags behind the voltage, and represent the relations with vectors. Thus in fig. 2, the vector E, rotating counter-clockwise, represents the voltage. It may be imagined as "caught" by a camera in the position shown at a certain instant. The vector I, representing the current flowing from A to B was also caught at the same instant as it follows along behind the voltage vector. It will be seen that the current, measured by the distance of the head of the arrow from the horizontal line (fig. 2) changes from one direction to the other and reaches its positive and negative maxima after the voltage. The amount of lag depends on the inductance, though the current never lags the voltage by more than a quarter of a cycle or 90° difference in vector position. When the current lags, it is impossible to supply the maximum power over a given system. The power at any instant equals the product of instantaneous voltage and current. If the voltage is a maximum when the current is zero and vice versa, that is, if the angle of lag is 90°, the power flows out and then back in equal amounts so that the net power delivered is zero. The more nearly the lag approaches 90° the less is the net power transmitted to the load by a given current and voltage. But, independently of whether the lag is zero and the power delivered a maximum for a given current and voltage, or whether the lag is 90° and the power a minimum, the maximum voltage and current are limited by the capacity of the generating and transmitting apparatus because excess voltage would result in insulation failure and excess current would cause a high temperature and extreme electro-mechanical forces, either of which might cause an interruption to service. The net power delivered which of course is the only fraction of the power that does useful work, is equal to the product of the current and voltage multiplied by the power factor, a factor equal to the cosine of the angle between the voltage and current vectors. The net power delivered is measured in kilowatts or active kilovolt amperes.

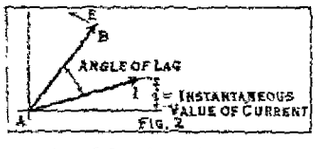


FIG. 2

As said before, the maximum power which the generating and transmitting system can deliver is reduced when the power factor is low, that is to say—when the angle of lag is large. The excess generating capacity represented by this reduction in maximum net power delivered serves merely to pump energy into the system during part of the cycle and to receive it back during another part. This energy is called the reactive power and is found by multiplying the product of volts and amperes by the reactive factor. Thus there are active and reactive kilovolt amperes to be supplied. There are, however, two types of reactive power; that due to a lag of current behind the voltage, already described, and that when the current leads the voltage. The latter tends to neutralize the former so that with equal amounts of leading and lagging reactive power there would be left only the true active power. Such an ideal situation rarely exists, however.

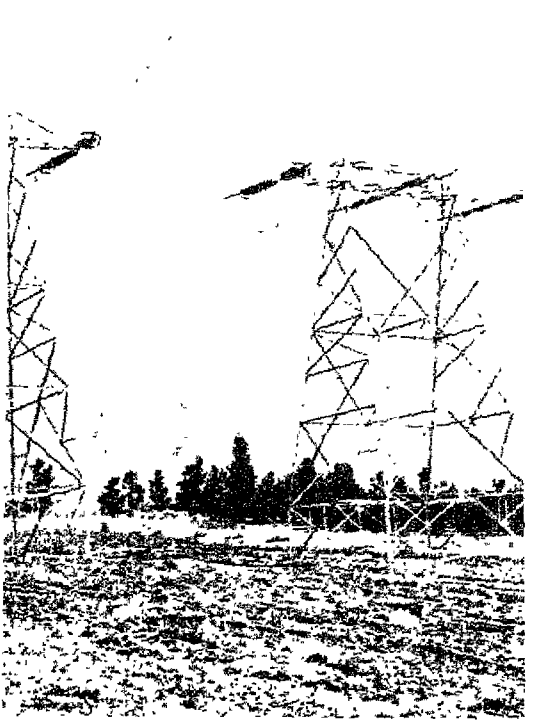
The leading current arises from capacitance, the ability of parts of the circuit to store electrical energy in a static condition (condenser effect), just as the lagging power factor is caused by inductance, the ability of the circuit to store electrical energy in a magnetic condition. Electric lights cause no lag of current, but most motors and other apparatus, in which there are magnetic or capacity effects, draw a lagging current, so that usually the power to be sent over a transmission line is at lagging power factor, thus giving rise to a certain inefficiency which cannot be avoided, but can only be reduced to a minimum by proper design. The transmission line itself possesses both inductance and capacitance, factors which create several transmission problems. In the first place the line inductance of itself causes a further lag of current and requires more lagging kilovolt-amperes from the generating source. Furthermore, the inductance is related to the resistance of the line. In absorbing reactive power it causes a drop of voltage similar to the drop of voltage caused by the resistance in absorbing active power, except that the reactive voltage drop is a maximum when the current is a minimum, producing the effect of a lag of reactive voltage drop of 90° behind the current. As a result, if the current is in phase with the impressed voltage the reactive drop is a maximum when the impressed voltage is zero, or the reactive drop lags 90° behind the impressed voltage. The effect is to delay the time when the voltage arrives at the far end of the line. If the current is just a quarter cycle behind the impressed voltage the reactive drop subtracts directly from the impressed voltage. Conversely, if the current leads the impressed voltage by a quarter of a cycle the reactive drop adds to the impressed voltage producing a higher voltage at the end of the line than if this drop did not occur.

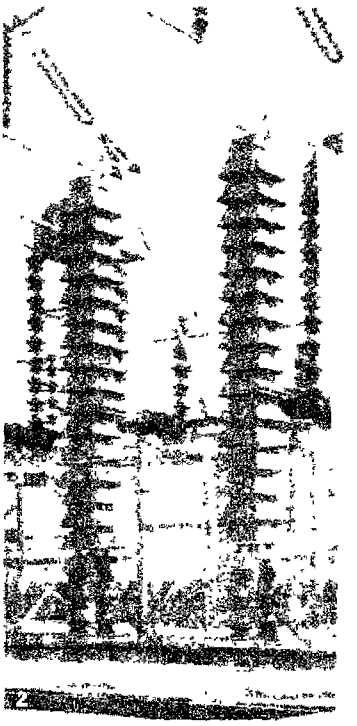
There are two principal effects of line capacitance. One effect is that it requires a so-called line charging current at leading power factor. When there is no lagging current required by the load the generator must supply the charging current in addition; when the load does require lagging current, the line charging current partially neutralizes it so that the generator must supply only the net reactive power. The second effect has already been alluded to; when the generator must supply a net leading current to charge the line, some of this current flows out to the farther part of the line, causing a rise of voltage

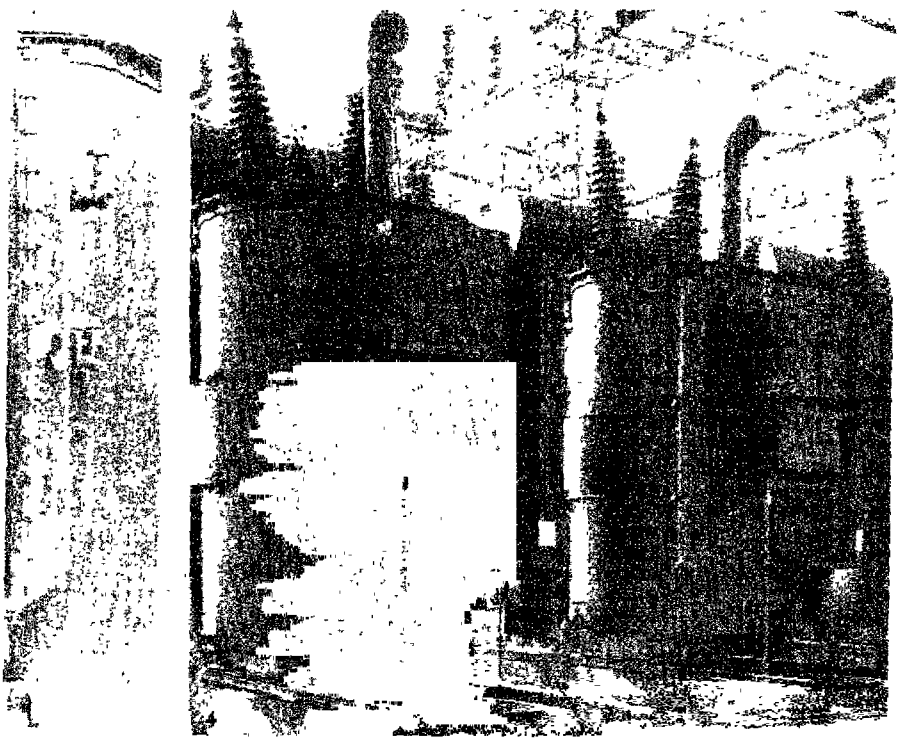
The values of the line capacitance and inductance depend chiefly on the size of wire and the distance between wires. Capacitance increases with the diameter of the wire and the closeness of the spacing. Inductance decreases with these factors.

Following the invention of the transformer came another contribution of great importance to the alternating current system. This was the development of the three-phase system by Tesla and others about 1890. The original single-phase system consisted of only two wires through which the current flowed. The three-phase system combined three phases into one system so arranged

ECTRICAL POWER TRANSMISSION







OR CORPORATION. (2, 3, 4) THE GENERAL ELECTRIC COMPANY, U S A

IPMENT FOR HIGH TENSION ELECTRIC POWER TRANSMISSION

ee phase high tension circuits in southern
nsulator arrangement is designed to stand
d in the transmission line

r arresters used to protect 220,000 volt
lumns of lead oxide units, covered by
e the lightning voltages induced on trans-
lerstorms and thus prevent interruptions

3. Small power transformer for subway service on network system. The device in cabinet aut network and is widely used in urban lighting throughout the United States
4. Outdoor substation showing bank of transformer structure supporting conductors overhead. High main line is here transformed and controlled f local feed lines

that the voltage of one phase should be a positive maximum at a certain time that of another should be at a positive maximum a third of a cycle later and the third voltage two thirds of a cycle later than the first; this would institute a complete cycle and would be followed in turn by a second positive maximum of the voltage in the first phase. All three phases could be sent over only three wires. Mathematical analysis showed that almost twice the power could be transmitted over 1.5 times the copper, as with the single-phase system with a resultant important saving. Any two of the wires could be used independently to form one phase.

Since the advent of the three-phase system there has been growth in size, power and voltage of transmission systems but no radically new developments (in fact there are some few systems in Europe, known as Thury systems, where direct current is still used).

Design of a Transmission Line.—With this preparation the problems that enter into the construction of a transmission line may be considered. Surveys must be made to estimate future power requirements, various possible sites for a steam generating station or a water power station must be studied. With these factors established the best route for the transmission line must be found. To determine this route a preliminary airplane reconnaisance may be made followed by a careful survey; then come the acquirement of right-of-way and the work of clearing it out, erecting poles and towers, and stringing the conductors on the insulators.

Before the latter stages of this work are begun the transmission voltage must be decided on. Although this is usually about 1,000 volts per mile, the actual value depends on the amount of power to be transmitted and various other factors as well as the distance. Against the cost of the conductor, decreasing as the voltage is increased, must be balanced the increased cost of insulation, spacing, and towers throughout the line. Of equal importance are the means to maintain service in case of a failure on the system.

Corona.—Among the factors that affect the choice of the conductor, aside from the current to be carried, is the phenomenon known as corona. As the voltage on a conductor is increased beyond a certain point a hissing sound will be audible and in the dark a glow can be seen around the conductor (Plate II., fig. 3). The voltage at which this phenomenon occurs depends upon the diameter of the conductor, its surface, the distance between conductors, and the atmospheric conditions. Corona is due to a partial breakdown or ionization of the air around the conductor. Its importance arises from the loss which it causes, a loss which varies as the square of the excess voltage above the starting potential. At high voltages a small percentage variation in voltage means a considerable absolute change and considerable loss will result unless the conductor is of such a diameter that the starting voltage for corona is above the operating voltage, at least under normal atmospheric conditions. This means, with a voltage of 220,000 volts, a conductor at least 0.95 in. in diameter and usually more. A solid copper conductor of this size would often contain more copper than necessary to carry the power, so conductors of aluminium, or copper with a steel core, or even hollow copper conductors are sometimes used for high voltage transmission.

Since corona does not begin until a certain voltage is reached the current flowing to supply the corona loss flows only while the voltage is near its maximum value in the cycle. A current flowing in this way is the equivalent of a triple frequency current. Corona is not the only phenomenon affecting the conductor. As the size of the conductor increases the current tends to concentrate near the surface, thus in effect reducing the cross-section of the conductor. This is called the "skin effect." To reduce the skin effect the conductor is made of strands twisted together.

Transmission Line Insulation.—The problems of insulation are much more complicated than those which concern the size of conductor, and equally important, for if transmission is to increase the reliability of electric power, the interruptions of service which the transmission system itself causes must be reduced to a minimum. Obviously the lines must not fall, or cross or swing against towers. Yet the system may comprise hundreds of miles of line exposed to wind, storm and lightning.

The mechanical stresses are relatively simple and may be mentioned first. Normally there is the weight of conductors to be supported. At certain points there must be tension sufficient to keep the conductors from sagging too far. The wind often exerts heavy side pressures on conductors and towers. However the worst stress occurs when sleet freezes around the conductor creating a cylindrical mass 3 or 4 in. in diameter. The dead weight is very much increased and the increased area augments wind stresses. In localities where storms are frequent and severe, copper conductors with steel cores are sometimes used to give a high tensile strength.

The electrical stresses are most acute on the insulators holding the conductors at each support and in the apparatus connected to the line. The thousands of insulators used all along the line must have sufficient dielectric strength to resist the continuously applied voltages. Dirt may collect on them, rain may wet them, but still they must continue to insulate. In the early days this was a hard requirement to meet. The type of insulator chiefly used on high voltage lines is shown in Plate II., fig. 2. Formerly the chief cause of failure, aside from poor materials or design, was that the voltage stress did not divide evenly over the insulator string. The disc nearest the line was subject to excess stress. To eliminate the concentration of stress, grading shields were introduced (shown at ends of the arc, Plate II., fig. 2). This device divides the stress evenly over the string. The shield has the further advantage that if an arc does occur it strikes through air instead of cascading along the surface of the insulators and weakening them.

Lightning Protection.—The most severe stresses are caused by transient voltages arising from switching operations and, particularly, lightning storms. Since the stresses due to switching are less severe than, and of a character similar to, lightning, only lightning phenomena will be discussed. When lightning actually hits a transmission line, the destruction of insulators or apparatus may follow if protective measures are not provided. The lightning voltage and energy will be drained off at the points where failure occurs.

Lightning, however, need only strike in the vicinity of a transmission line to cause abnormal voltages. When a cloud bearing an electric charge passes over a transmission line, the charge on the cloud induces a charge on the transmission line, the charge on the line being of opposite sign to that on the cloud. So long as the charge remains on the cloud the line charge is held in place by attraction and is known as a bound charge. The line voltage also is held to low values. However, when the lightning strikes to ground or to another cloud, the cloud charge is drained off in a few millionths of a second. The charge on the line is suddenly released and its voltage increased. It starts travelling out in both directions along the line putting increased stress on all the insulation. Lightning voltages have been studied on transmission lines and in the laboratory, by means of a generator which produces sudden voltages of the same sort as lightning. Voltages as high as 5,000,000 volts have been employed for such tests by the General Electric company in its laboratory at Pittsfield. Plate II., fig. 2 shows a discharge produced by this "lightning generator." Miniature towns, transmission lines, and clouds have been built to scale—likewise devices called surge recorders have been used on transmission lines to measure the voltage set up by lightning.

From these investigations a considerable amount of data has been collected, and as a result apparatus highly resistant to lightning has been built and protective measures for life and property have been devised. It appears from measurements of the induced voltage on transmission lines, and of the length of lightning strokes, that the voltage is of the order of 100,000,000 volts. This voltage exists between clouds or between cloud and earth until the moment of discharge, then it is drained off in a few micro-seconds. The maximum current may be perhaps

...000 amperes and the total energy of the discharge 4 kilowatt-hours. The voltage appearing on the line will vary as the height of the line. It frequently attains a value of 50,000 volts per foot height of line, but may approach 100,000 volts per foot of height. Such voltages are far in excess of normal operating voltages and may cause arcs to strike across the line insulators. Such an arc may constitute either a short-circuit or an arcing ground and is very undesirable in either case. The lightning voltage stresses the apparatus even more than the line.

The voltage may be reduced in several ways. In the first place the high voltage causes corona which drains the energy of the surge and the high current flowing through the line resistance drains more energy. The loss in energy is accompanied by a decrease in voltage. The voltages can also be reduced to approximately one half by stringing a wire, called a ground wire, along the tops of the line supports and connecting it solidly to ground.

Devices known as lightning arresters are usually connected between each line wire and ground, close to the transformers at each end of the line. Plate I., fig. 2 shows a group of lightning arresters. Their function is to drain off the energy represented by the freed lightning charge. At ordinary operating voltages they do not allow line currents to pass, but where lightning surges traverse the line, the arresters become conducting and thus discharge the high potential charges harmlessly to ground. Their characteristics are such that they do not permit line current to follow the lightning currents, but immediately restore their high resistance by automatic action. This action is, unfortunately, not characteristic of line insulator breakdowns, and consequently disastrous sustained power arcs may follow lightning disturbances if the insulators are not large enough.

But the danger of the lightning voltage is much greater than indicated by its mere magnitude. This increased danger lies in its rapid rate of increase or impulse character. Ordinary 60-cycle voltage rises from zero to a maximum in a quarter of a cycle or $\frac{1}{240}$ of a second, but a lightning impulse rises to maximum value in perhaps one millionth of a second, and may be all over when a 60 cycle voltage is just beginning to rise. When the voltage is of this type, much higher values are required to break down the line insulators and apparatus because it lasts so short a time and is not repeated. On the other hand the effect of such impulses is to concentrate all of the voltage across the first few turns of a transformer. For this reason these turns are specially insulated and shields have been developed to distribute the stress evenly over the whole winding. Such care is taken in building the transformer because, however undesirable it may be for a line insulator to break down, a transformer breakdown causes a greater damage. A short-circuit or ground results in either case but a breakdown of the transformer places it out of service for some time and incurs heavy expense. Also an insulator flashover or breakdown can often be taken care of by removing the voltage from the transmission line.

This problem demands careful co-ordination of transformer and line insulation. If the transformer insulation is weaker than the line insulation the transformer fails; if the line insulation is weak the excess voltage flashes over a line insulator and the arc may remain to form a short-circuit. The best solution seems to be offered by using a transformer insulation which is stronger than the line insulators in its immediate vicinity. Suitable protective devices are also generally desirable. Another problem is whether to operate with a certain point in the system, called the "neutral," connected to ground. If such a connection is not made, an accidental grounding of one line, or an insulator flashover, will produce a very high transient voltage and probably a short-circuit will result; if the system is grounded an accidental line ground causes a short-circuit directly, but there are no extreme voltages to injure the insulation permanently. Heavy third harmonic or triple frequency currents are more likely to result when the system is grounded.

Oil Switches.—However imperative it is to maintain service, there may be mentioned short circuits and grounds. Under such conditions it is necessary to disconnect the transmission line from the generator. As will be explained later, special circuit arrangements make continuous service possible even when there is a short-circuit, if the affected portion of the line can be removed from the system. Although there are other reasons for desiring switches, it is the problem of short circuits that has developed a particular form of switches known as oil circuit breakers. The problem lies in the fact that under short-circuit conditions the heavy current makes it difficult to break the circuit. The increasing voltages, too, have had their effect in increasing the difficulty of making proper circuit breakers. A switch group is shown in Plate II., fig. 5. The switch itself, immersed in a special oil possessing very high insulating properties, is made so that the contacts will open as quickly as possible, making it difficult for the arc to follow. Also, the space for the arc is restricted so that the gas pressure evolved by the arc forces the contacts apart and blows out the arc itself.

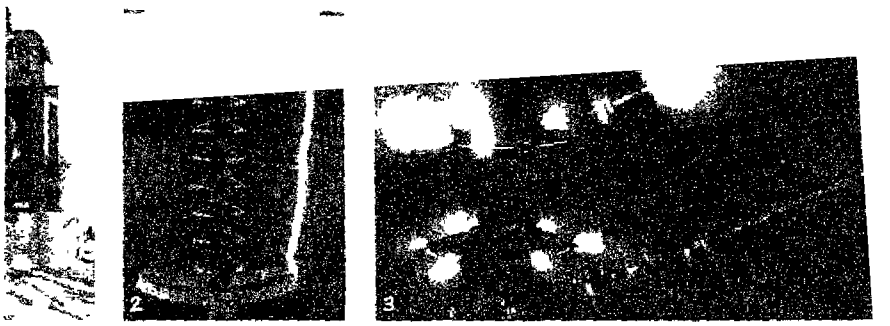
Transmission and Distribution Systems.—There are several types of transmission systems. A generating station may deliver power over one circuit to a distant point. As a rule, however, two circuits at least will be used so that if one fails the other may be kept in service. Such an arrangement would be typical of a water power station feeding a distant centre. At the generating station there would be the oil circuit breakers, transformers and lightning arresters. At the receiving end, besides the step down transformers, switches and arresters, there might be a synchronous condenser. This is a rotating machine similar to a generator which supplies reactive power at either leading or lagging power factor as required. Sometimes when the load power factor is low, capacitors are used which take a leading current in the same manner as the line capacity and raise the power factor.

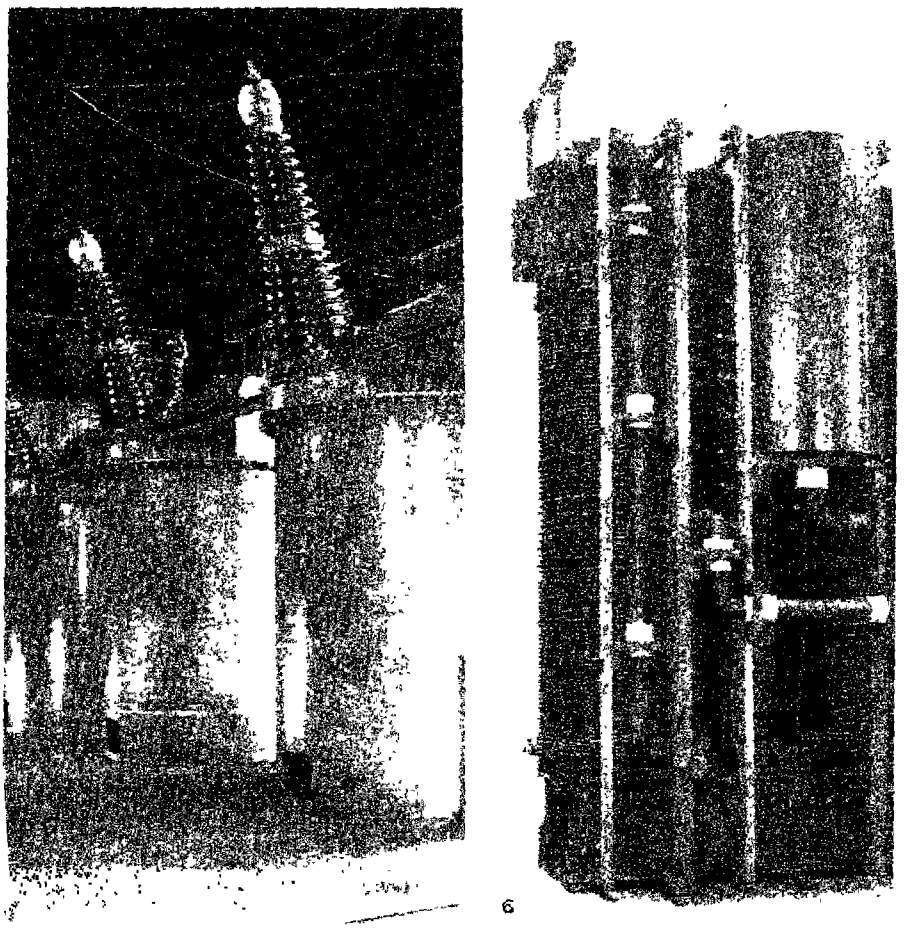
The station at the receiving end is commonly called a substation. There the power is transformed to a lower voltage. Out from the substation, supply lines or "feeders" radiate at reduced voltage, ordinarily 2,300, 4,000, 6,900, 11,000 or even up to 25,000 volts. The loads are supplied from the secondary windings of transformers whose primaries are connected across the feeders, located near the buildings supplied. The early scheme was to run the wires from a particular transformer secondary, to the building or buildings supplied. Thus a group of buildings receives its power from a certain definite transformer.

In recent years another plan has been adopted for cities where the load in a given area is heavy. The secondaries of all the transformers are connected together, making a secondary network. Several transformers may feed to a concentrated load and if one transformer fails the service is not interrupted. One development of this scheme employs several feeders covering approximately the same area. When the load is light one or more of the feeders is switched off at the substation, whereupon switches on the secondaries of the transformers associated with the disconnected feeders are opened, removing the transformers from the system and saving the losses which they occasion even when supplying no load. The secondary switches referred to, and other automatic devices necessary to control the flow of power in case of a failure, constitute the most serious difficulty presented by this arrangement.

The substation as an intermediate step between the transmission and distribution systems may seem an unnecessary complication, but in fact, it is economical. A small transformer designed for direct connection to a high voltage system would cost several times as much as one for connection to a relatively low voltage feeder. Since the higher voltage does not make so much difference in a large transformer it is cheaper to step down the voltage from the transmission voltage in a few large units, and to use lower voltage feeders in which the power is divided and the current small and to which the cheaper distribution transformers can be connected.

After this brief description of distribution systems the more complicated transmission systems may be considered. There is, first, the radial system where a central generating station must supply several substations surrounding it. Such a system is





NY, U.S.A.

)S OF CONTROLLING HIGH POWER ELECTRIC TRANSMISSION

f circuit breaker, used to disconnect ider short circuit, operation is auto- power system

ing of insulators. The rings at top nields, serve the double purpose of enly over the string and holding the rom the string of insulators

s at super voltages, due to ionization Bright glow in centre indicates the ss a nine foot gap. Photograph was camera

4 Capacitor used to couple a carrier current telephone wireless," to high tension transmission lines. This sound waves to be carried over the main power systen cation with distant stations along the high tensio system

5. Group of oil circuit breakers, 400 amp. capacity, use volt high tension transmission lines. Unit control oil breakers to operate simultaneously, ensuring pr station

6. Interior or structural view of a large power transform volt power system, showing circular disc coil const windings. This is one of the highest voltage trans on any transmission line

similar to that previously described except that several lines radiate from one station. The more developed system is of the ring type in which two lines start from the generating station and after being tapped at several substations meet again. The advantage is that power can flow to any station in either of two directions.

Finally, there are transmission networks which are made by a combination of the radial and ring systems and offer several paths for power flow to each station. The gain from having more than one path is twofold. Power can be fed over the most economical paths and in case of trouble on one line, others can be used to supply power.

A final stage is the interconnection of generating systems, so that each system can be fed by several stations. The advantages are manifold. When there is trouble anywhere, there are many directions for feeding the desired power and many sources that may be used. With so many generating sources, the amount of spare capacity is reduced as compared to that which an isolated station would have to have to maintain service in case of a generator failure. The area covered is larger and the diversity greater, so that the total capacity required is less.

The interconnection of water-power and steam power stations is very advantageous. Ordinarily in a water-power plant the investment cost is higher, the operating cost low; in a steam plant the ratio reverses. By interconnecting, the water-power station can be operated at nearly full capacity all the time. For such operation the total cost is only a little more than if operation were only at, say, 10% capacity. Only when the peak or maximum load comes on is the power taken from the steam station. Thus steam power, with its high operating cost, is used as little as possible, while hydro-electric power, with its high fixed investment charges, is used as much as possible

Such interconnection involves many problems, however. Before operation can be effected at all, all of the apparatus on the system must be held to exactly the same frequency of alternation and to definite phase relations. When one station speeds up a little it takes more power and the others less. This tends to slow down the faster station, but the force may often be too small, and if the generators once pull out of step large amounts of power surge back and forth and there is a probability that the whole system will be stalled. Even when the stations do not pull out of step the directions in which the power is forced to flow may be undesirable for economic reasons.

Aside from mere mechanical excellence of the speed regulating devices a supervisory control of the whole system must be exercised to control the exchange of power both active and reactive. This is done by the chief load dispatcher, who has in front of him a plan of the whole system dotted with indicating devices to show the position of switches, generators and other apparatus. (*See* ELECTRIC POWER GENERATION.)

The load dispatcher must receive information from all points on the system. This is often carried out by means of carrier current telephony—that is, telephony making use of radio frequency which is sent over the transmission lines themselves. The telephone circuits at both ends of the transmission line are coupled to the line electrically by means of capacitance, or, less frequently, inductance. Plate II., fig. 4 shows a capacitor used for this purpose.

However, the control which the dispatcher can exercise over the flow of power is limited by the circuit constants and the voltages that must be held at certain points. In general the flow of active power depends on the lag of voltages with respect to each other: the flow of reactive power on voltage magnitudes. The supply of reactive power costs little in steam and may best be supplied from relatively inefficient stations of earlier design. This leaves the supply of active power to the most efficient stations; *i.e.*, modern steam stations or hydro-electric stations where "fuel" is cheap per kilowatt-hour generated.

Ordinarily the transformer does not allow any change in the ratio of voltage during operation, but such a change may be desirable to control the flow of reactive power. It is obtained by a special transformer arrangement known as load ratio control which allows the changing of the number of active turns in the windings and hence of the voltage during operation.

Other very complicated aspects of transmission should be mentioned. Oil switches are necessary, but useless unless properly controlled. If when trouble occurs it were necessary to locate it by tests and to open switches by hand, the system would be out of operation or burned up long before anything could be done. Schemes dependent on devices called relays, have been developed which automatically locate all sorts of trouble and then open just those switches which disconnect the affected part and leave the rest of the system in operation. These relays may be operated by temperatures, under- or over-voltage, over-current, over-power, reverse-power, unbalance of currents etc. They may have various sorts of time delay. They may even be actuated by carrier current.

Telephone Interference.—A problem, which in a way is extraneous, is that of acoustic interference with telephone circuits. Telephone lines are conveniently placed parallel to power lines. So placed, they are exposed to induction from the power line, that is, the heavy current in the power lines sets up a magnetic flux which links the telephone wires, thus inducing a voltage in them. This voltage acts on the telephone receivers and confuses the sound of the voices. If the power current is very heavy the noise may be so great as to give a listener a severe acoustic shock.

If the three power conductors could be so arranged that they were equidistant from both telephone wires there would be no interference, because in a three-phase system the relations of the currents are such that one is always the equal and opposite of the other two. The voltage induced by any one power line would be nullified by the other two. As it is impractical to arrange the conductors with the desired symmetry at any point, an approach is made to this by transposition, that is by rearranging the conductors on the poles regularly after a certain distance has been traversed.

Transposition cannot always be made completely effective, particularly when it is triple frequency (third harmonic) currents rather than those of fundamental (operating) frequency which cause the interference. Triple frequency currents occur with certain transformer connections and flow out along all three conductors, returning through the ground. Transposition between ground and lines is impossible, so the telephone wires offer the only opportunity for transposition, but one that it is difficult to make effective. Circuits made of inductances and capacitances and called "filters" are frequently used to filter out these undesired voltages from the telephone circuits.

The Trend of Transmission Development.—Some of the limitations to the further development of transmission may be interesting. In general there is no purely technical obstacle to prevent the use of transmission voltages higher than the present maximum of about 220,000. Research has been carried out with values far in excess of present voltages, and if economic factors should require higher voltage transmission it could be accomplished. In general, economical transmission at high voltage requires large amounts of power available for transmission to considerable distance. Approximately 100,000 kilowatts is usually required per transmission line for economical 220 kilovolt transmission.

Large amounts of power per line introduce a problem which must always be considered. The greater the flow of current over a given transmission line with a given amount of inductance, the greater is the lag of the receiver voltage behind the generator voltage. Therefore, when it is attempted to increase the power transmitted over a line by increasing the current flowing, the lag of the receiver voltage behind the generator voltage becomes greater. But the maximum power that can be transmitted over any given line under present circumstances is obtained when the receiver voltage lags the generator voltage by about 90°. Longer transmission lines mean more inductance, and hence more lag. Beyond the 90° point, therefore, the maximum power decreases, or, in other words, the longer the line the less power can be transmitted.

Another factor, namely the increase of charging current with added length of line, also tends to cut down the maximum power carrying capacity of the line. This line charging current, being 90° in the lead of the generator voltage, and reacting within the generator operates to raise the generator voltage. In order to keep the voltage down to normal, the magnetic field supplied to the machine by the exciter (*see* ELECTRIC POWER GENERATION) must be cut down. Therefore, the larger the charging current required of the machine, the less the field that can be carried. But it is only the current produced by the action of this field on the generator windings that gives useful power. So, to keep down the voltage, the power output of the machine must be sacrificed. To allow the voltage to rise would ultimately result in destruction of the insulation of the system.

This whole situation is termed "stability," and is one of the limiting factors in long distance power transmission. Methods of increasing the stability limits of a system have been devised, and the problem constitutes one of the principal fields of study for transmission engineers to-day.

The stability problem on long lines is accompanied by other serious conditions brought about during short circuits. The principal factors here are the increased line voltage drop due to the exceedingly heavy currents flowing, and the inability of the generators and other synchronous machines to adjust themselves promptly to the short-circuit condition. The machines are no longer held to the same speed because the reactions which occur are not strong enough to hold the system stable. Increasing the speed of response of the electrical machine, however, overcomes these difficulties in considerable measure. All of these problems are called problems of stability.

As a whole, the requirement that a system be stable tends to limit both the distance of transmission and the amount of power at present voltages, but the problem is being solved through the use of specially designed apparatus. Higher voltages involve an increase of cost as compared to present voltages, unless the amount of power and the distance of transmission are very much increased.

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(F. W. P.; D. D. C.)

ELECTRIC CHARGE. An electrified body is said to have acquired an electric charge (*see* ELECTRICITY). The unit of electrical quantity is the *unit charge* (*see* UNITS, PHYSICAL, and ELECTRON).

ELECTRIC EEL (*Electrophorus* [*Gymnotus*] *electricus*), a South American fish which, in spite of its external similarity, has nothing to do with the eels (*Anguilla*), but belongs to the order Ostariophysi, which includes the carps or *Cyprinidae* and the catfishes or *Siluridae*. The dorsal and caudal fins are rudimentary or absent, and the anal long, extending from the anus, which is under the throat, to the end of the body.

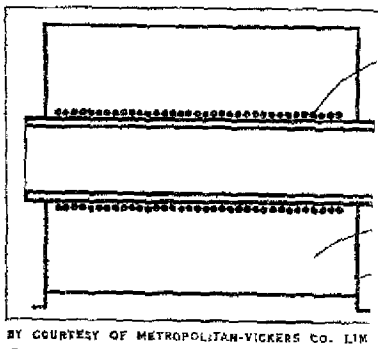
Electrophorus is the only genus of the family which possesses electric organs. These extend the whole length of the tail, which is four-fifths of the body. They are modifications of the lateral muscles and are supplied with numerous branches of the spinal nerves. They consist of longitudinal columns, each composed of an immense number of "electric plates." The posterior end of the organ is positive, the anterior negative, and the current passes from the tail to the head. The maximum shock is given when the head and tail are in contact with different points on the surface of some other animal. *E. electricus* attains a length of 3ft. and the thickness of a man's thigh, and frequents the marshes of Brazil and the Guianas. When this natural battery is discharged in a favourable position, it is sufficiently powerful to stun the largest animal. These fish are eaten by the Indians, who are said by Humboldt first to exhaust their electrical power by driving horses into the ponds. The strength c size and condition of the fish. Sev power of discharging electricity but t can genus *Malapterurus* of cat-fish c the raash (*M. electricus*) of the Ni rivers; in habit it is sluggish and the passes from head to tail.

Less developed than in either of th electric rays or torpedoes also have t charge; the most famous of these southern Europe. The discharge passe

Electrical power has been indepen these groups.

ELECTRIC FURNACES. All their operation on the fact that when path a certain proportion of the electr heat energy. The amount so converte the resistance offered by the path energy.

One of the simplest forms of elect type furnace in which heat is gener tricity through a conductor of a r ensure the conversion to heat of the Furnaces of this type may depend t tors or non-metallic conductors. Of widely used are nickel-chromium all and tungsten, are used to a lesser ex depending on the temperature at v the furnace. For temperatures up t is used, but for higher temperatures above must be employed. If molybd is necessary that these should be ope which oxygen is excluded, the norma materials being to use them in a f stant stream of hydrogen is passed of this type, temperatures of at lea In cases where it is not possible to e be used for temperatures up to abou of platinum being its high cost. I the conductor is usually arranged in winding on a tube of refractory mate in an outer case filled with some h has to be taken that the refractory in contact with the winding are als trial furnaces of this type usually built of fire-brick, strengthened on work and fitted on the inside with ir

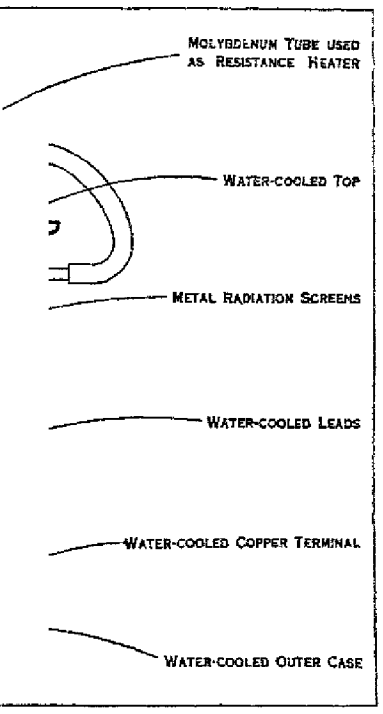


BY COURTESY OF METROPOLITAN-VICKERS CO. LIM

FIG. 1.—DIAGRAM OF WIRE-WOUND RES FURNACE

the wire or tape is wound. Furnace heat treatment of steel and gener the present, the only metallic wind to the atmosphere has been a n higher temperatures have been de nitrogen, steam and various other iron tape resistances have been use of the resistance type the whole c converted to heat, it is essential ir efficiency that good thermal insula

may be obtained by using a high
rm of sheet The reason for this is
btaining refractory materials which
of 1,600° C or over, and which do
ith the metal through which current
eet it is possible to avoid the use of
h it necessitates a radical alteration
An example of a furnace of this



ENUM SHEET TUBULAR RESISTANCE

molybdenum sheet functions as the
wall of the furnace chamber It is
es of gradually increasing diameter,
a water-cooled copper jacket, the
leads and top. It is necessary to
ray vacuum before raising its tem-
he first is the necessity for having
t with the metal, and the second is
uction of heat either directly or by
a gaseous medium. The outer con-
nation shields. The disadvantage is
tube which functions as the heating
very low voltage and a very large
itating the use of a special trans-
e furnace. Its advantage is that by
using molybdenum, temperatures
of the order of 2,000° C may be
attained quickly, owing to the
small heat capacity of the furnace.

The earliest types of resistance
furnace employing non-metallic
resistances normally consisted of
two concentric tubes of electrical
insulating refractory material;
E the space between them was filled
de with carbon granules or powder,
through which a low voltage
hey had the disadvantage that their

Another type of furnace employed
of a helix machined from a graphite
ated under special conditions, as for
oxidising atmosphere, in order that
ed
on-metallic resistors in the shape of
i utilised. These chiefly consist of a
d some suitable binding material

Furnaces have been constructed and operated utilizing these as resistance elements fixed on insulating supports attached to the inner walls. Such furnaces are used mostly for temperatures between 800° C and 1,200° C. The chief disadvantage of elements of this type is the gradual change in resistance which occurs as the life of the element increases, this increase of resistance in some cases being of the order of 100 per cent. The latest type of non metallic resistor to appear by 1928 was in the form of a flat bar consisting of some carbonaceous material, together with a binder which has been fired at a high temperature and then glazed with an inert refractory. The main industrial application of these up till then had been for the ceramic industry. The furnaces developed in this connection have been regenerative tunnel kilns in which the heating elements are placed in the centre of a long tunnel. the ware being passed through continuously at a speed appropriate to the temperatures which it is desired to attain. Two such kilns are placed in close juxtaposition, the ware being passed in opposite directions in the two kilns so that the hot ware leaving each kiln gives up a large portion of its heat to the cold ware entering the other.

One specialised form of electric resistance furnace is the Wild Barfield furnace for the heat treatment of steels. The temperature to which certain steels have to be heated for treatment coincides with the temperature at which they become non-magnetic. This fact is utilised to make the furnace automatic.

Arc Furnaces.—The first electrical furnaces were arc furnaces in which attempts were made to use the high local heat generated by the arc. Rapid progress was made with these furnaces which are now soundly established in industry. Although in detail they vary greatly, in principle they conform to three main types. In the first type electrodes are inserted through either the walls or the roof, the arc or arcs being formed between the electrodes The whole is above the metal contained in the furnace hearth the heat transfer being effected almost entirely by radiation. As this is not direct heating, the thermal efficiency of this type of furnace is not as high as is desirable. In some types an attempt to increase this thermal efficiency is made by directing an arc electromagnetically down against the contents of the furnace This type of furnace has, however, been almost entirely superseded by other types in which the electrodes are inserted through the roof of the furnace and current passed from them to the metal In some cases the current passes from one electrode to the metal through the metal and then to the other electrode or electrodes depending upon whether one, two or three phase supply is being used. In other furnaces an electrode is inserted in the bottom of the furnace, this electrode carrying part of the current from the metal. The advantages claimed for this latter type of furnace are that short arcs may be used, giving a higher thermal efficiency inasmuch as the arc is brought into closer contact with the metal On the other hand a disadvantage is the high local temperature attained at the surface of the metal, where the arc strikes it This high local temperature is very objectionable when volatile metals are being melted. Furnaces have been constructed up to 40-tons capacity and can be used either for melting cold scrap or for the refining of the molten steel. They are used chiefly for the production of high grade steels Carbon electrodes are used, these being gradually consumed, much of the carbon passing into the molten metal, a disadvantage when alloys with a low carbon content are required. The furnaces are almost invariably made to tilt.

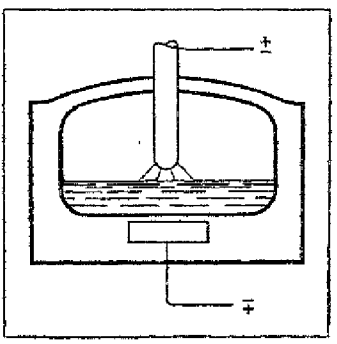


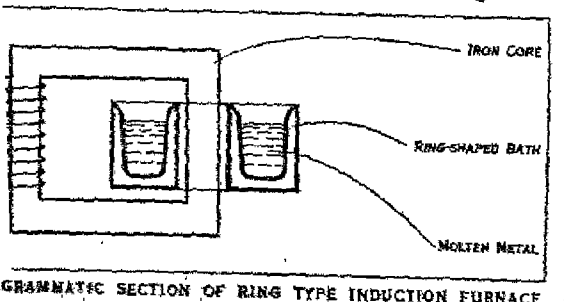
FIG. 4.—ELECTRIC ARC FURNACE
In this design, the current passes from a top electrode through the metal and conducting hearth to a bottom electrode

Another type of arc furnace is one in which the electrodes dip into a bath of a molten salt, the current operating in two ways The passage of the current from one electrode through the molten salt to the other electrode gives a resistance heating effect keep-

ıolten, whilst the electrolytic action of the current
e salt giving a deposit of metal on one electrode.
ocess used in the production of aluminium from

Furnaces.—Furnaces of the induction type depend
their operation upon resistance heating. Although
ıot electrical connection between the electrical sup-
etal in the bath in a furnace of the induction type,
irect connection by electrical induction. They may
ssed into two groups, the cored induction furnace
ss induction furnace. The cored induction furnace
'sts of an annular, ring-shaped bath which acts as
winding of a transformer. The transformer core
on circuit, the ring-shaped bath and the primary
round one leg of this. The furnaces so constructed
rranged to tilt, and from the purely electrical stand-
efficient.
ıelting, a furnace of this type, but so arranged as to
ɔir of metal above the ring, is known as the Ajax-
These furnaces have the disadvantage that a con-
ɔf metal is necessary in the trough. They must be
ıring in molten metal and this reduces the flexibility
ɔ from the standpoint of melting alloys of different
Furthermore, there is always a danger of the metal
ining if it is allowed to solidify in the ring part of

ʏpe furnace for steel making has been somewhat
ɔr other types, but for brass melting the core type
a metal reservoir is both efficient and satisfactory.
uous operation not be maintained the efficiency of
s seriously impaired. Owing to the action of the
ic field, forces are brought into play which tend to
ɔross section of the metal to such an extent that if
e large enough the column of liquid metal in the
be broken. This effect, of course, varies with the
ty of the metal and is much more serious for the
the heavy metals.
ulties are eliminated by the introduction of the core-
ı furnace, known as the Ajax Northrup High Fre-
ıce, as this permits the use of a standard crucible and
necessity for a ring type bath and continuously
e. In this furnace the metal to be melted is con-
ucible, which in turn is surrounded by a water-cooled
which the supply current is passed. It has been
ome time that if a very high frequency current be
a coil such as described, the metal in the bath would
ırrents induced in it, which, provided conditions were
generate sufficient heat to melt the charge. It has
ı discovered that for a melt of given resistivity, the
ɔquency which is necessary in order to melt a charge
nace is dependent on the diameter of the charge to be



AGRAMMATIC SECTION OF RING TYPE INDUCTION FURNACE

example, with a crucible 15" in diameter, it is possible
ɔ using a 500-cycle supply, whereas in the same cru-
ɔssible to melt brass using a supply with a periodicity
ations per second. As these periodicities can easily
by the use of rotating machinery, furnaces operating
ɔuite are of commercial utility.
ction furnace has the advantage that the melting time
ced to a very short period. Very thorough mixing of
is obtained and it can be kept free from any contami-
n outside sources. This property is one which is of

especial value when it is required
Accurate control of the temper
necessity for keeping a minimum
molten. The furnace can easily
charge, whilst the fact that the
itself means a low metal loss due

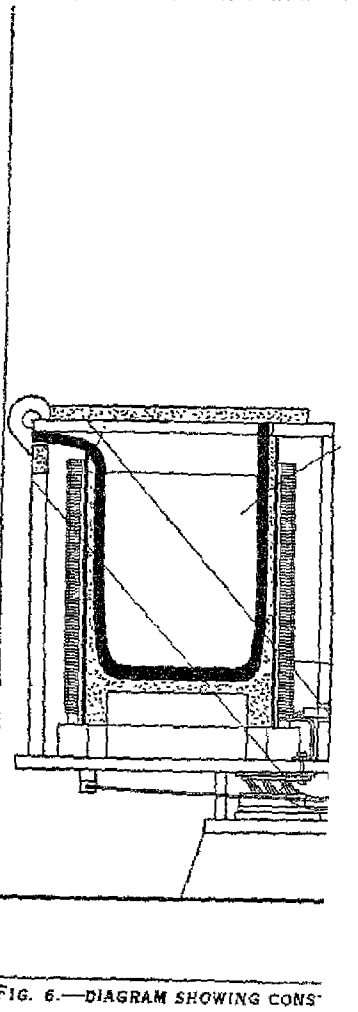


FIG. 6.—DIAGRAM SHOWING CONS

BIBLIOGRAPHY.—A. Stansfield, *Steel;* W. Rodenhauser and I. S *Iron and Steel Industry;* N. R. *M.-V. Gazette* (Sept. 1925); C. of Induction Furnaces," in *Phil.* D. F. Campbell, "Electric Furna *Engineering,* 123 (pp. 334-336, "H. F. Inductive Heating," in *F* 1926); G. Ribaud, "Contributio electric furnaces," in *J. de Phys* Aug. 1926).

ELECTRIC GENERAT
mechanical into electric powe
motion of a system of electr
field. The term "dynamo," fo
electric generator or motor, is
erator consists of a *field,* cor
and south magnetic poles spac
of a concentric *armature* built
system of electrical conducto
mechanical structure that per
respect to the armature by e
field being held stationary in
ductors are so connected th
passage across the magnetic fi
The field poles are magnetized
one or more encircling coils. c

History.—Faraday, in 183
between the poles of a horse
tinuous current from it by cl

con ac s on on the per phery ard the o her on the shaf o the c c Th frs elect c generator w s a homopol mach ne w h ra a ur ent pa hs S nce s field was pro ided by a permanent ma net, the magnetic density was extremely low, and since the current paths were not definitely controlled, it was extremely inefficient. The next year, H. Pixii developed and constructed the first heteropolar machine, and provided it with a wire armature winding. The voltage produced was alternating, so to secure a continuous voltage he constructed the first commutator, reversing the current every half cycle. In 1845 another real advance was made when Wheatstone replaced the permanent magnet fields with electro-magnets, which he made self-exciting in 1857. The introduction of the "ring-winding" of Paccinotti (1860) and Gramme (1870) solved the problem of connecting in series any number of the conductors of a multipolar dynamo, thus adding their induced voltages, while yet affording mechanical means of holding them in place on the surface of the revolving armature. It was used extensively in various forms during the next 20 years, but was finally replaced by the "barrel" or "drum" type winding of Alteneck (1871), which was a development from the earlier "shuttle" winding of Werner von Siemens (1856). The greatest defect of the ring winding is that the currents existing in the return conductors on the inside of the armature core produce large magnetic fluxes which greatly impair the generator characteristics. The barrel winding overcame the difficulty, and greatly reduced the amount of copper required, by joining the ends of conductors under opposite poles by connections across the ends of the armature. When it was found how much the magnetic densities could be increased by decreasing the air gap length between field and armature, the slotted armature was generally adopted. This consummated a great advance, as embedding the armature winding in slots (first proposed by Paccinotti in 1860) not only reduced the air gap length, but also reduced eddy current losses in the copper by removing it from the intense magnetic field; and made the mechanical design immensely more rugged. In order to avoid ruinous eddy current losses, due to the cyclic alternation of the magnetic flux, it was early realized that the armature iron must be laminated. Edward Weston and Edison were the first to appreciate all these factors, however, and the latter's bipolar dynamo at once raised the standard of generator efficiency from about 50 to the then unheard of figure of 90%. This machine had a much greater ratio of iron to copper weight than earlier generators, and had the first mica insulated commutator. Hopkinson's paper on dynamo-electric machinery (1886) gave the first rational method of calculating generator performance, and so put designing on a solid foundation. Edison's inventions of his bipolar dynamo in 1878, of the incandescent lamp in 1879, and the "Edison system" of central station power production in 1882, gave the first real commercial impetus to electric generator and power development, and thereafter it progressed rapidly. In 1881 C. F. Brush made the first "compound wound" generator, by adding an auxiliary field winding in series with the armature, and thus solved the problem of automatic voltage regulation of direct current generators. The invention of the carbon brush by Van Depoele in 1888 revolutionized direct current generator design by improving commutation and reducing commutator wear immensely. In the early '90s, parallel operation by means of external equalizer connections was discovered, and in 1896 Lamme invented the internal equalizer connections, which ensure an equal division of the current between parallel armature current paths, and which made really large generators practical. Thereafter larger and larger multipolar generators, directly connected to reciprocating steam engines, came into use, reaching a peak of development about 1900. Since then, the invention of the "commutating pole" and many refinements of design have greatly improved direct current generator performance, but fundamental design features have not changed markedly. The use of direct current is now restricted to the congested sections of large cities, and to special purposes, as for the drive of variable speed machinery, for electrolytic work, and for electric railways. Most of this power is first generated as alternating current and then transformed to direct current by means of o a on er e s mercury arc rectifiers, or motor generator se

The invention of the first alternating current system of power production and distribution by Zipernowski and Deri, Gaulard and Gibbs in Europe, and by William Stanley in the United States (1885), and of the induction motor by Nikola Tesla (1888), initiated a new trend in generator development. Stanley's most successful alternator commercially was of the inductor type, having one central field coil carrying direct current from a separate "exciter." The magnetic flux did not alternate, but simply pulsated, so that the voltage induced in each armature conductor comprised both an alternating and a continuous component, the continuous voltages being cancelled by the series connection of conductors one-half pole pitch apart in the reverse direction. When the alternating current frequencies were reduced to 25 and 60 cycles from their early high values, the double weight of core this construction entails led to its abandonment, and it was replaced by the synchronous alternator with "chain" windings.

In the early types revolving armatures were used, following the design of direct current generators, but the disadvantages of making a rotary high voltage armature with slip rings and brushes soon led to the adoption of the rotating field design. By 1902, the average size of central station generators in the United States had increased to 100 kw., and over 60% of all were alternators. The development of the steam turbine (*q.v.*) by Parsons, Curtis and Emmet, and the very rapid increase in size of central station then led to a new stage of development, in which the turbine replaced the reciprocating engine. The first large steam turbine driven alternator in the United States was built by the American General Electric company and installed in Chicago in 1903. It was rated 5,000 kw., and was of the vertical shaft type. Its immediate success led to the almost universal adoption of steam turbine driven polyphase alternators for large central stations, a practice which has since continued. After a few years, turbine alternators were designed, almost entirely, with horizontal shafts and revolving fields. Refinements in design have resulted in larger and larger machines, till now ratings of 50,000 kw. at 13,200 volts and 1,800 revolutions per minute (r.p.m.) in a single unit are common in the United States, and much larger ones are available, while voltages up to 22,000 are used. Accompanying the growth of large central stations in the cities, hydro-electric plants using waterwheel driven alternating current generators have grown proportionately. The three phase 100 kw. Lauffen generators designed by C. E. L. Brown (1891) and the two phase 5,000 kw. Niagara generators built by the Westinghouse Company (1894), both vertical shaft machines with external revolving fields, are notable examples of early progress. W. M. Mordey, H. F. Parshall, Elihu Thomson, B. G. Lamme, G. Kapp, Ganz and many others contributed much to the rapidly growing art, but since 1900 developments have been carried on by co-operative enterprise of the engineers of large corporations, rather than by individuals. In the United States, waterwheel generators are almost universally of the laminated salient pole revolving field type, with double layer (drum) armature windings of machine wound coils in open slots. In Europe, the field poles are generally made solid, or with the tips only laminated; and chain type armature windings, consisting of hand wound coils, or bars, in closed slots are often used. Kilowatt ratings up to 30,000 at 514 r.p.m. and 65,000 at 107 r.p.m. have been built, and there is no obvious limit to the possible size at the lower speeds.

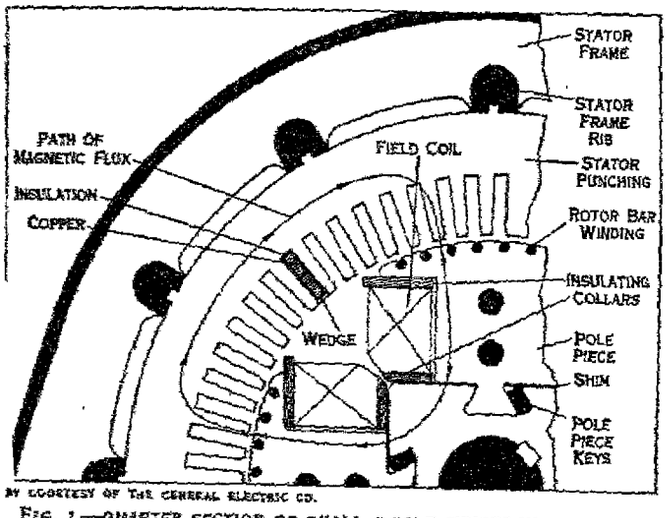
In the late '90s, when polyphase alternating current (a.c.) was superseding direct current (d.c.) supply, and before the steam turbine was adopted, steam reciprocating-engine-driven alternators were built, with ratings up to several thousand kilowatts and speeds well below 100 r.p.m. Since the advent of the internal combustion engine, many power plants have been built with oil engine driven generators, and the high efficiency and economy of the Diesel engine has brought it under consideration for large projects. Alternating current generators for this service are similar in construction to waterwheel generators, except that the former must be provided with damper or *amortisseur* windings and often with extra flywheels to limit the electric oscillations set up by

e pulsating torque of the engine. Increasing specialization and refinement of design have marked recent generator development. mproved insulating and ventilating methods have so increased eliability that base power generation is being concentrated in elatively few units of very large size. In the early days, alterator voltage regulation was a difficult problem. A solution was ttempted by the use of self-excited alternators, but automatic oltage regulators have since been highly developed, and are now elied upon almost universally. The construction of the first ydrogen-cooled machine by the American General Electric company in 1928 typifies the constant improvements in efficiency and ze reduction in size of machines being made.

Types of Generators.—A generator merely converts mechanical power into electric power. The highest object to be attained n generator design is, therefore, to make a machine that will (1) eceive mechanical power in the form most conveniently produced from the available source of energy; (2) deliver electric ower in the form most easily utilized for the purposes desired; nd, (3) function with the least energy loss in the conversion, vith the greatest reliability of operation, and at the least cost

Generators are logically classified in accordance with the way n which these three objectives are met. Arranged in accordance vith the type of mechanical drive, and in order of their importance, there are: (*a*) Steam turbine-driven generators, (*b*) waterwheel-driven generators, (*c*) engine-driven generators, (*d*) electric notor-driven generators. In accordance with the type of electric power they deliver, and their electrical design, they are divided nto: (*e*) Synchronous generators (a.c.), (*f*) generators with commutators (normally d.c.), (*g*) induction generators (a.c.), (*h*) nductor generators (a.c.), (*i*) homopolar generators (alternating l.c.).

In mechanical construction, any generator can be made with a horizontal or a vertical shaft, with radial (disc type) or axial conductor arrangement, and with the field inside or outside of he armature. The most usual construction has a horizontal haft, with axial conductors, and outside armature. Exceptions are type *f* machines, which have the armature inside, and ype *b* machines, which are now commonly made with vertical shafts. Of the various types, the engine-driven continuous current generator (*c*, *f*) was by far the most important during he early years of electric development, due to the pre-eminence of the reciprocating steam engine as a source of primary power, and the preference for direct current, but it was little used in 1928. The development of the electric transformer and the



BY COURTESY OF THE GENERAL ELECTRIC CO.

FIG. 1.—QUARTER SECTION OF SMALL 4-POLE SYNCHRONOUS MOTOR

steam turbine brought type *a* into the lead about 1905, and [illegible] have made type *b*, *e* of great importance also. The advent of efficient gas and oil engines, notably the Diesel engine, have in recent years brought type *c*, *e* into prominence too. The advantages inherent in alternating current power generation and transmission have made it common to produce direct current power, when required, by conversion from alternating current power, so that direct current generators are now most frequently of type *d*, *f*. Other types of generator are of minor importance in the production of primary electric power, though they are useful in special applications, as *d*, *h* for the production of high frequency alternating currents. Any generator can be used as an electric motor (*q.v.*), but in practice only types *e*, *f* and *g* are so used. An intermediate variety of machines that is much used is the synchronous condenser, which is really an electrically driven synchronous generator of reactive power, or a generator of type *d*, *e*, in which the driving motor and the generator are combined into a single machine. Such a machine draws from a system a very small energy current and returns to it a large magnetizing current. Another important intermediate variety of machine is the "synchronous converter," which is really the combination of a generator of type *d*, *f* with a synchronous driving motor. By building a synchronous motor as shown in fig. 1, with revolving armature and a direct current generator with common windings, the incoming and outgoing armature currents can be made largely to cancel each other, so that a greatly increased output can be secured from a given amount of material. A large proportion of all the direct current power now generated is produced by such converters.

Theory of Generator Design.—All electric generators operate by virtue of the principle discovered by Faraday (*see* ELECTROMAGNET), that the passage of magnetic flux across a conductor forming part of a closed circuit produces a current in the circuit. The current always flows in such a direction as to create a force opposing the relative motion of flux and conductor, by virtue of the reaction between the new magnetic flux created by the current and the original flux. The instantaneous voltage generated in the closed circuit is given by the equation

$$e = BLV\ 10^{-8} \text{ volts} \qquad (1)$$

where B is the average magnetic flux density at the conductor in gausses, L the length of conductor in cm. in the magnetic field at right angles to the direction of rotation, and V the velocity of motion in cm. per second. A general type construction, which has been found to be satisfactory for the usual medium speed synchronous generator has been developed. The field poles are magnetized by the "exciting current" carried by the field winding. The magnetic flux flows in planes perpendicular to the shaft, and crosses the air gap twice to complete its circuit. Consequently, the voltage induced in each armature conductor reverses its direction each time a pole passes by, or the voltage "alternates." For many reasons, it is desirable to make the time variation of voltage sinusoidal, and so the magnetic flux distribution around the periphery is also made approximately sinusoidal. Except in homopolar and inductor machines, therefore, the voltage induced in the armature by the magnetic flux alternates in time at a frequency:

$$f = \frac{NP}{120} \text{ cycles per second} \qquad (2)$$

where N is the speed of the flux in revolutions per minute, and P is the number of poles. When a continuous current is desired, it is necessary to rectify the induced voltage by means of a commutator. The operation of an electric generator also depends on a second law of electromagnetism (*q.v.*), that was discovered by H. C. Oersted, and which states that a current of i amperes flowing in a conductor of length L cm. at right angles to a magnetic field of density B gausses, produces a force at right angles to the conductor equal to:

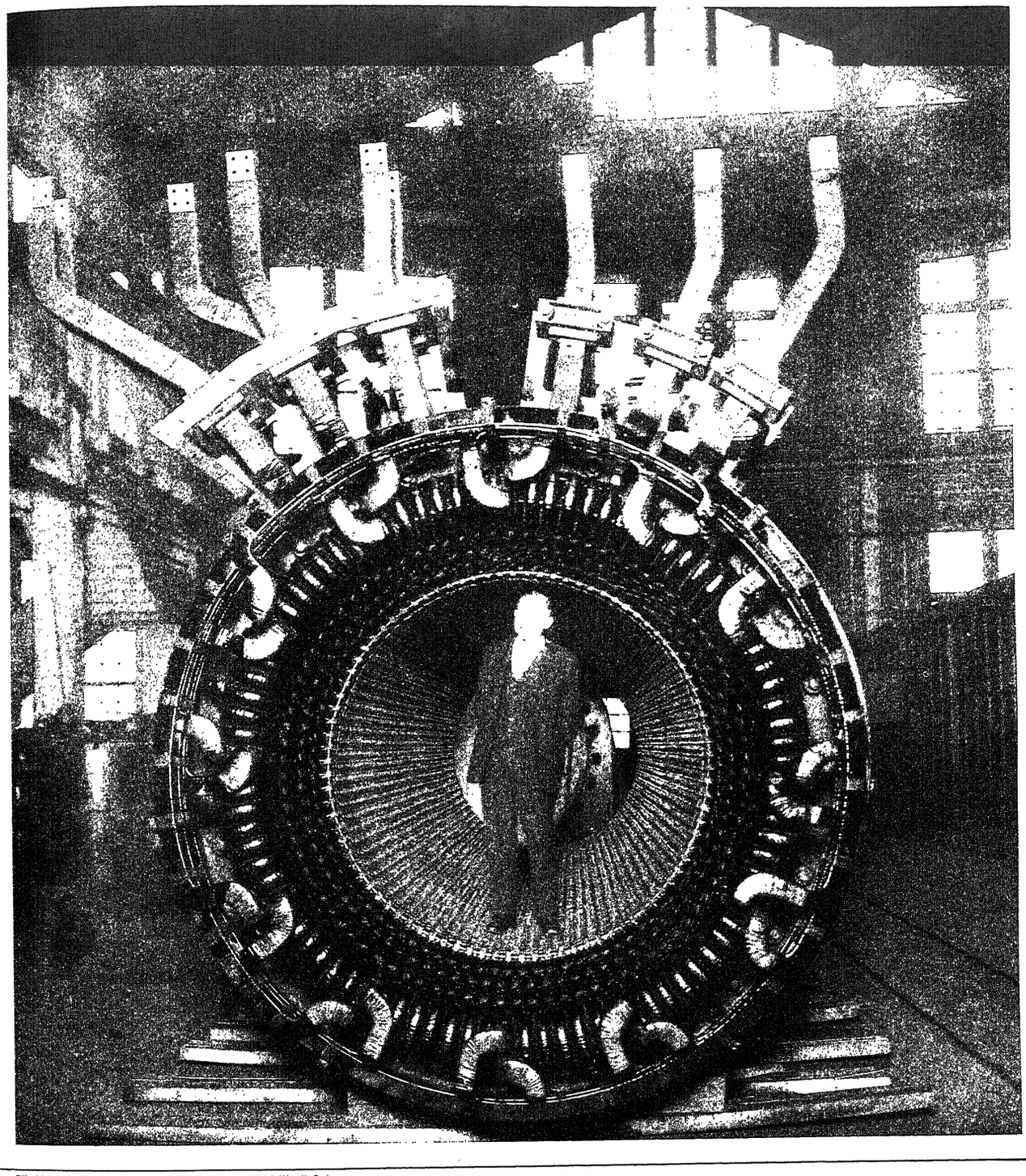
$$F = BLi\ 10^{-1} \text{ dynes.} \qquad (3)$$

As the total current that can be carried in the armature conductors without excessive power losses is roughly proportional to its diameter, D cm., and as the power input is proportional to force times speed, the power rating of a generator, from (3), is approximately proportional to:

$$\text{Power} = (BL)(D\Delta)(V) = (kB\Delta)(D^2LN) \qquad (4)$$

where Δ is the "current loading," or number of ampere conductors per cm. of periphery, and k is an "experience constant." Equation (4) shows that for given densities of magnetic and electric

ELECTRIC GENERATOR



BY COURTESY OF THE GENERAL ELECTRIC COMPANY, U.S.A.

STATIONARY PART OF A LARGE ELECTRIC GENERATOR

End view of stator winding and connections, with supports assembled on the inside frame. This section of the generator, known as the *armature*, consists of a series of electro-magnetic circuits forming a hollow cylinder. Within this cylinder the *field*, a steel drum, carrying another electric circuit, revolves, to generate electric power in the armature